



1007393



HUMAN HEALTH RISK ASSESSMENT

GE AIRCRAFT ENGINES - EVENDALE

Prepared For:

**GE Aircraft Engines
Cincinnati, Ohio**

Prepared By:

**ChemRisk - McLaren/Hart
Cleveland, Ohio**



**Project No. 080803673002
April 6, 1998**



GE Aircraft Engines

General Electric Company
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(513) 243-6272

April 8, 1998

Daniel Patulski
USEPA Region V
RCRA Permitting Section
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77 West Jackson Boulevard
Chicago, IL 60604

Re: General Electric Company
GE Aircraft Engines
OHD 000 817 312

Dear Mr. Patulski:

We are sending under separate cover the Draft *Human Health Risk Assessment* for GE Aircraft Engines - Evendale. You should be receiving the copy of this report within the next few days.

If you have any questions, please contact me at (513) 243-6272.

Sincerely,

Gregory H. Jaspers, PE
Sr. Environmental Engineer

Report under separate cover.

cc: W. Killoran
M. Norman, VSSP
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ATTACHMENT

RESPONSE TO USEPA COMMENTS ON THE DRAFT HUMAN HEALTH RISK ASSESSMENT FOR THE GEAE FACILITY OCTOBER 29, 1998

Responses to General Comments

1. As requested, the HHRA was modified to include arsenic and beryllium as COIs in soil (and sediment) for all Operable Units, where applicable. Discussions related to regional background data for arsenic and beryllium were removed in the HHRA. The marginal excursion (less than 3-fold) above site-specific background levels occurs frequently at industrial sites because of the nature of industrial operations and the use of fill material for land development from sources other than the facility. The NCP guidance recognizes that minor excursions above site-specific background is likely to occur for industrial properties and addresses this issue in a statistical manner. The NCP states that concentrations of inorganics that are 3-fold or less as compared to background levels are not a concern.
2. All literature citations were corrected in the final HHRA.

Responses to Specific Comments

1. The text was revised to reflect the proper section number.
2. Additional text was provided in the HHRA when additions or deletions occurred to the PCOI list that was originally presented in the HHRA Work Plan.
3. See response to General Comment #1.
4. Background comparison and health-based benchmark evaluation tables and a summary figure showing the COI selection process are included in Data Evaluation for each exposure medium. The tables present the actual comparisons and the figures summarize the COI selection process for that medium. In addition to identifying COIs, the summary figure clearly identifies the chemicals that were eliminated from further evaluation for that medium and in which step in the COI selection process they were eliminated. The purpose of the Data Evaluation is to identify which chemicals may potentially be of concern at the site. Chemicals that were eliminated in the background comparisons or the health-based benchmark evaluations have been eliminated from further consideration since they do not pose any human health concerns. Therefore, it was considered unnecessary to list these chemicals in the text since they are clearly identified in the tables and figures. Instead, the discussions are focused on chemicals that may potentially be of concern at the site (COIs).

The statements that PCOIs "do not appear to be associated with a release from a SWMU" were removed in the final HHRA.

5. The references to IRIS and HEAST were revised to reflect the most current versions (USEPA, 1998 and 1997, respectively) and updated values were incorporated into the final HHRA.
6. Toxicological profiles were consulted for chemical-specific information for absorption, where a default value of 1 was assumed. Where reliable information was available, the ABS value of 1 was revised. However, in the absence of chemical-specific data, ChemRisk maintains that a default value of 1 is both reasonable and health-protective based on the following rationale.

Most of the COIs for which an AFo value of 1 was assumed are VOCs, a class of chemicals which generally are absorbed rapidly and completely due to their mobile nature. While EPA has focused their comment on the absolute absorption of COIs by the oral route, it is more pertinent to redirect attention on the relative absorption of the dermal pathway (ABS) vs the oral pathway (AFo). In the HHRA, ChemRisk has adopted a conservative ABS value for VOCs (0.25). Therefore, the relative absorption efficiency for the dermal to oral pathway using the default AFo of 1 is 25%. This is a conservative assumption considering the following:

- The skin is an absorptive barrier whereas the gastrointestinal tract is not;
- Absorption of the chemical is encouraged in toxicity studies through the use of media in which it is readily available (oil, water, feed), whereas this is not the case for chemicals in soil, particularly in aged soil (Alexander, 1995); and
- The ABS term of 0.25 generally does not consider loss from contacted soils due to volatilization processes, and is no longer used by USEPA, Region IX (1996a) in deriving preliminary remediation goals (PRGs) for VOCs (a value of 0.1 is used instead).

In extreme cases, focussing attention on the absolute absorption of COIs by the oral route (AFo) without addressing the absolute absorption by the dermal route (ABS) can result in unrealistic relative absorption efficiencies. Consider beryllium as an example. Chemical-specific information indicates the AFo for beryllium is 0.005 (USEPA, 1997). However, if the default ABS value for inorganics of 0.01 is applied, an unrealistic relative absorption efficiency of 200% is realized when calculating dermal hazards and risks.

7. CALC was defined in Table 4-6 as "calculated from the unit risk value".
8. Footnotes were added to Table 4-8 to indicate the source of the dermal absorption parameters.

9. The use of a 95th UCL of the arithmetic mean is a conservative approach that is used to characterize exposures (*i.e.*, direct contact with a medium) and account for uncertainty in the measurement process and distribution of a chemical in a medium. The use of sampling data in fate and transport analyses involves defining a "contaminant zone" using actual measurements. Models are then used to extrapolate from measured values in one medium (*e.g.*, soil) to predict a concentration in another medium (*e.g.*, air). The contaminant zone can be modeled as a single source term using the measured concentration for a sample location, or as an area source using data from all sample locations. For screening purposes, an area source is typically used for a simple analysis of fate and transport and this approach requires the use of conservative assumptions. The modeling analysis used an average concentration as the source term. This is adequately protective of human health since additional conservatisms, applied and inherent, are used in the performance of a modeling evaluation.

From the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) p.5,

" The Superfund program's method to estimate the RME for chronic exposures on a site-specific basis is to combine an average exposure point concentration with reasonably conservative values for intake and duration...An average concentration term is used in most assessments where the focus is on estimating long-term, chronic exposures."

Both *Soil Screening Guidance: Technical Background Document* (USEPA, 1996b) and *Superfund Exposure Assessment Manual* (USEPA, 1988) give equations and describe source term concentrations as using averages when conducting long term release calculations.

For the GEAE facility, the depth of contamination was assumed to be the entire depth of soil sampling which was 30 feet for OU2 and 22 feet for OU1. This value is used despite the general tendency of site contamination to be located in isolated "pockets". The area of contamination was considered to be the entire area of the source boxes shown in Figure 5-1 of the HHRA. Given the above source term parameters, the area source location designated OU2-1 was characterized in the HHRA as being contaminated with benzene over 105,000 m² to a depth of 30 feet. Additionally, an examination of site maps and aerial photographs show that concrete, asphalt or buildings cover 75% or more of OU2-1. No barrier to volatile migration from soil to air was considered in the modeling analysis.

Given the conservative parameters used to characterize site conditions, the use of the UCL (which may be the maximum concentration) would be overly conservative and provide little meaningful data as to potential hazards at the site. The conservative screening models used in the HHRA (Jury (BAM), ISC-ST3, and the indoor mass balance box model) overestimate airborne concentration for the

reasons discussed in the uncertainty analysis (Section 6.6) of the HHRA. Modeling results using MLE (average) and 95th UCL concentrations were compared for the air pathway. For key chemicals of interest, the results using MLE and 95th UCL concentrations vary slightly (less than 2-fold) except for trichloroethene (TCE) (10-fold). The 95th UCL concentration for TCE in OU1 is the maximum detected concentration. There is little uncertainty that the maximum concentration of TCE (14 mg/kg) does not exist from 0 to 22 feet throughout the entire area encompassed by OU1.

In many cases, one measured value was available for groundwater at a monitor well. Therefore, the 95th UCL concentration was used to conduct the analysis. Additionally, the groundwater data set was not as robust as the soil data. In some cases, a single sample was collected as far back as 1990. Additional uncertainty exists regarding the fluctuations in volatile concentrations due to varying water levels and source contribution. These uncertainties were accounted for by using the 95th UCL. A discussion of the uncertainties associated with the use of the 95th UCL was added to the HHRA.

10. Table 5-2 was revised.
11. Modeling results were negligible (*i.e.*, zero) at this duration for the two compounds. A footnote referencing the modeling output (Table 5-13) was added to Table 5-16.
12. Additional text was added to Section 6.1.1.
13. As requested, the text was revised accordingly to eliminate discussions related to the significance of estimated risk values.
14. The text in Section 6.5 was revised.
15. The degradation rate term for the Jury model was conservatively ignored in the screening level modeling analysis. An additional discussion was added in the uncertainty analysis (Section 6.6) of the HHRA.
16. Table 6-17 was revised.
17. There is some confusion since Appendix A did not include an EPA letter dated September 9, 1997, as EPA noted in their comments. The last page of the EPA letter dated August 28, 1997 was missing and will be included with the final HHRA.

RESPONSE TO ADDITIONAL USEPA COMMENT

(Dated 31 August 1998)

Data for the following wells were inadvertently excluded from the draft HHRA and have been incorporated into the groundwater data sets, as summarized below.

Data Set

Wells

Operable Unit 1

Perched Groundwater

GM-8P, GM-9P

Operable Unit 3

Perched Groundwater

GM-6P

Upper Sand and Gravel Groundwater

GM-6S

Lower Sand and Gravel Groundwater

GM-6D, GM-7D

Operable Unit 4

Perched Groundwater

GM-1P, GM-10P, GM-11P

Upper Sand and Gravel Groundwater

GM-1, GM-10S, GM-11S

References

Alexander, M. 1995. How Toxic are Toxic Chemicals in Soil? *Environmental Science and Technology* 29(1):2713-2717.

USEPA. 1988. U.S. Environmental Protection Agency. Superfund Exposure Assessment Manual. Office of Emergency and Remedial Response Directive 9285.5-1. April, Washington D.C. EPA/540/1-88/001.

USEPA. 1996a. U.S. Environmental Protection Agency. Region IX Preliminary Remediation Goals (PRGs). San Francisco, CA.

USEPA. 1996b. U.S. Environmental Protection Agency. Soil Screening Guidance: Technical Background Document. Office of Solid Waste and Emergency Response. Washington, D.C. EPA540/R-95/128.

USEPA. 1997. U.S. Environmental Protection Agency. Health Effects Assessment Summary Tables (HEAST), FY-1995. Washington, DC.

USEPA. 1998. U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS).

INSTRUCTIONS

Please update the original document with the attached replacement pages/sections.

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All pages

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Revised/New Figures

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Revised Tables

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Section 7

Entire section

Section 8

Entire section

Appendix A

Insert as last page to the EPA letter dated
August 28, 1997

^(a) "A, B, C, etc" after number indicates new table.

HUMAN HEALTH RISK ASSESSMENT

FOR THE

GE AIRCRAFT ENGINES

EVENDALE FACILITY

April 6, 1998

Prepared for:

General Electric Aircraft Engines
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Prepared by:

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1.0 INTRODUCTION

This report presents the results of the Human Health Risk Assessment (HHRA) conducted by ChemRisk® on behalf of General Electric (GE) Aircraft Engines for the Evendale, Ohio facility (the site). The GE Aircraft Engines (GEAE) facility is located in Hamilton County in southwestern Ohio, approximately 12 miles north of Cincinnati (Figure 1-1).

1.1 Purpose and Objectives

The purpose of the HHRA is to provide a risk-based interpretation of the data collected during the RFI phase of the corrective action process and provide estimates of potential health risks. The results of the HHRA can also be used to prioritize corrective action and identify areas/solid waste management units (SWMUs) that may be considered for no further action. Specifically, the baseline risk assessment approach for the HHRA was developed from U.S. Environmental Protection Agency (USEPA) guidance to address the following objectives.

- (1) Quantify exposures and characterize baseline risks to potentially exposed individuals that are on or near the site.
- (2) Assist in focusing corrective action activities at the site.

The first objective is achieved by implementing standard risk assessment procedures according to USEPA guidance documents (see Section 1.4). The second objective of the HHRA is to assist in focusing corrective action at the site. Corrective action can be defined as remediation activities, risk reduction measures, containment and/or stabilization measures. The results of this HHRA, as well as the RFI, will be used to assist GE and USEPA Region 5 in risk management decisions at the facility in the future.

1.2 Risk Assessment and the Resource Conservation and Recovery Act

One of the goals of the Resource Conservation and Recovery Act (RCRA) of 1976 is to protect human health and the environment from hazardous waste generated as a result of industrial activity. Through the Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act, the USEPA has been given the authority to address releases of hazardous wastes through corrective action. Corrective action regulations address characterization and remediation of environmental contamination resulting from past hazardous waste disposal practices and operations that released chemicals to the environment. Although there are currently no finalized regulations governing the application of risk assessment to corrective action under RCRA, the regulatory mandate to utilize risk assessment is clearly expressed.

In July 1990, the USEPA proposed regulations for corrective action. Risk-based criteria were to be used in conducting remedial investigations and evaluating, selecting, and implementing remedies at hazardous waste management facilities (Federal Register, 1990). Most of these proposed

regulations have not yet been finalized and are considered guidance. In a 1993 final rule promulgating some of the proposed regulations governing handling of hazardous wastes generated from remediation activities, the USEPA reaffirmed its commitment to incorporate risk assessment into RCRA corrective action by stating: "Today's rule...should be viewed in the context of the Agency's overall strategy to establish comprehensive remediation regulations under RCRA...and is one of the first steps USEPA is taking in developing a *comprehensive risk-based regulatory framework*" (emphasis added) (USEPA, 1993a).

There are at least five objectives under the RCRA corrective action process where risk assessment may be used to guide site characterization and remediation decisions:

- (1) assessment of whether interim measures are necessary based on information collected during the RCRA Facility Investigation (RFI);
- (2) determination of no further action (NFA) after completion of the RFI;
- (3) determination of whether a Corrective Measures Study (CMS) is necessary based on the RFI;
- (4) establishment of appropriate cleanup goals as part of the CMS; and
- (5) determination of risks associated with corrective action management units (CAMUs) as part of management of remediation wastes.

1.3 Overview of Risk Assessment Approach

The approach that is followed for conducting the HHRA for the site incorporates the four fundamental components associated with the human health risk assessment process: (1) Data Evaluation; (2) Toxicity Assessment; (3) Exposure Assessment; and (4) Risk Characterization. These four components are described in detail in Sections 4 through 7 of the Human Health Work Plan (ChemRisk, 1997), which is included as Appendix A of this report.

The methodology for conducting the HHRA generally follows that presented in the *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual: Part A, Baseline Risk Assessment (RAGS, Part A)* (USEPA, 1989a). Additionally, several more recent regulatory guidance documents are considered in the preparation of the HHRA, as appropriate.

- *Exposure Factors Handbook*. USEPA, 1989b. Office of Health and Environmental Assessment, Washington, D.C. May.
- *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors*. Interim Final. USEPA, 1991a. Office of Solid

Waste and Emergency and Remedial Response. OSWER Directive 9285.6-03. Washington, D.C.

- *Risk Assessment Guidance for Superfund, Volume I. Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals)*, interim. USEPA, 1991b. Office of Emergency and Remedial Response, Washington, D.C. PB92-963333.
- *Dermal Exposure Assessment: Principles and Applications*. USEPA, 1992a. USEPA Office of Research and Development. Washington, D.C. EPA/600/8-91/011B.
- *Guidance for Exposure Assessment*. USEPA, 1992b. Federal Register 59(104)22888-22936. March 29, 1992.
- *Policy for Risk Characterization at the U.S. Environmental Protection Agency*. USEPA, 1995a.

These regulatory references provide general guidance and methodologies for conducting human health risk assessments and encourage reliance on site-specific information, as well as information in the peer-reviewed scientific literature. Accordingly, site-specific information and more recent scientific data are utilized, when available. Risk assessment analyses for the site utilizes the data collected during the RFI as well as post-RFI investigations. The results of the HHRA will provide useful information to determine if:

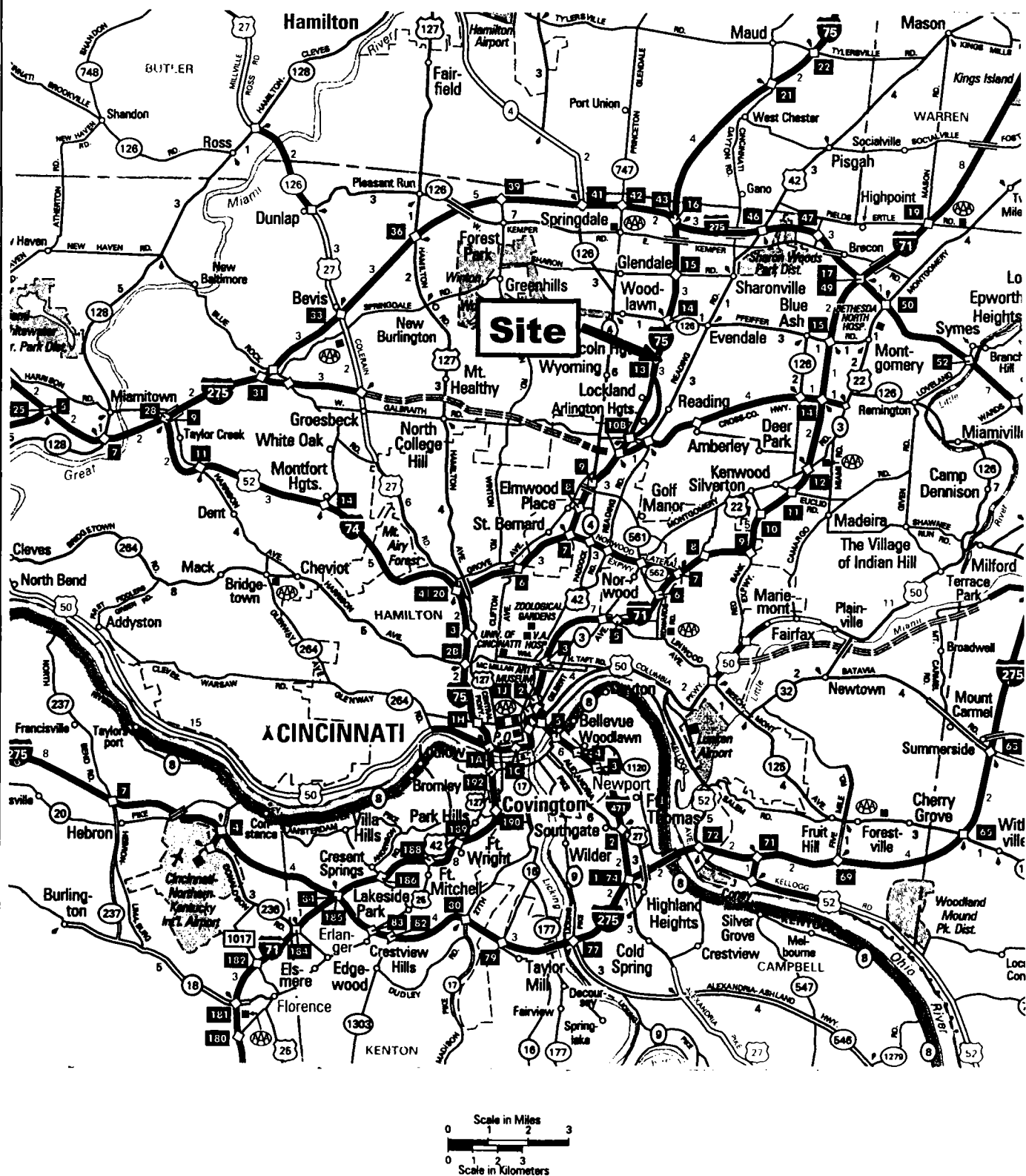
- (1) no further action is required,
- (2) further investigations are warranted, or
- (3) a Corrective Measures Study is necessary.

1.4 Report Organization

The remainder of the HHRA is organized as follows:

- 2.0 *Site Characterization*** - This section provides a brief description of the GEAE facility and the areas evaluated in this assessment.
- 3.0 *Data Evaluation*** - This section presents the results of the data evaluation process for the site.
- 4.0 *Exposure Assessment*** - This section identifies appropriate exposure scenarios for the site.

- 5.0 *Toxicity Assessment*** - This section presents the toxicity information that is used in the HHRA.
- 6.0 *Risk Characterization*** - This section identifies potential health risks which may be associated with the site.
- 7.0 *Conclusions***
- 8.0 *References***



Reference: AAA 1995 United States/Canada/Mexico Road Atlas



Filename: R:\3673\3673D001.DWG

FIGURE 1-1
SITE LOCATION MAP
GEAE

2.0 SITE CHARACTERIZATION

The characterization of the GEAE-Evendale facility and surrounding area focused on identifying current land use, potential human receptors, and plausible future land use for risk assessment purposes. For additional background information, refer to the RFI (OBG, 1995a). This section provides a general overview of the GE facility including its history and relevant physical features.

2.1 Site History

The Evendale plant was built in the early 1940s and GE operations began in 1948. GE began manufacturing military aircraft engines in the late 1940s and commercial aircraft engines in the early 1960's (OBG, 1995a). The adjacent Ford Motor Company warehouse and the U.S. Air Force Plant No. 36 (Plant 36) complex were acquired by GE in 1989.

On-site buildings include a variety of manufacturing and assembly buildings, test cells, shipping/receiving centers, office and storage space (OBG, 1995a). On-site generated waste included solid waste (paper, cardboard, construction debris, scrap metals, fly ash, batteries), sludges (water softening, electroplating, oil/water separators, wastewater treatment), and liquids (wastewater, waste acids/alkalis, waste solvents, waste oils). Waste management facilities included container storage areas, tanks, landfills, surface impoundments, paper incinerators, wastewater pretreatment systems, waste recycling areas and air pollution equipment (OBG, 1995a).

The former Plant 36, located on approximately 66 acres of land, includes a former nuclear engine research and test facility and four large above-ground storage tanks (for jet and diesel fuels). In addition, there were 21 underground storage tanks for jet and diesel fuels, gasoline, oils and water storage. These underground storage tanks have been removed (OBG, 1995a).

2.2 Site Description

The GE Aircraft Engines facility is located approximately 12 miles north of Cincinnati in southwestern Ohio's Hamilton County. The current facility is situated on approximately 400 acres of land at One Neuman Way in the Village of Evendale (Figure 1-1). The site is bordered to the west by Interstate 75, to the east by Conrail railroad tracks, to the north by Glendale-Milford Road (Route 126) and to the south by Shepherd Lane. In addition to the active Facility, GE owns property east of the Conrail railroad tracks as shown in Figure 2-1.

The GEAE property is divided into four Operable Units (OU) based on geographic and land use considerations (Figure 2-2). The levels and types of contaminants and exposure potential vary among the four OUs. A brief description, including current activities and public access to each OU is presented below. Operable Units 1 and 2 make up the GEAE Facility. Operable Units 3 and 4 encompass the additional GE owned property east of the railroad tracks.

2.2.1 Operable Unit 1

Operable Unit 1 comprises the original GEAE Facility (Figure 2-2). Operable Unit 1 is bordered to the west by Interstate 75, to the east by Conrail railroad tracks, to the north by Glendale-Milford road (Rout 126), and to the south by the former Air Force Plant 36. This OU includes a variety of manufacturing and assembly buildings, test cells, shipping/receiving centers, office and storage space, as well as a complex network of utilities to support the operations. Waste materials generated at the Facility have included solid waste (paper, cardboard, construction debris, scrap metals, fly ash, batteries, etc.), sludges (water softening, electroplating, oil/water separators, wastewater treatment, etc.) and liquids (wastewater, waste acids/alkalis, waste solvents, waste oils, etc.). On-site facilities for waste management have included container storage areas, tanks, paper incinerators, wastewater pretreatment systems, waste recycling areas and air pollution equipment.

A list of the SWMUs/AOCs included in OU1 is provided in Table 2-1. Current activities at OU1 include general worker activities associated with industrial operations.

2.2.2 Operable Unit 2

Operable Unit 2 is comprised of the former U.S. Air Force Plant 36 complex. Operable Unit 2 is bordered to the west by Interstate 75, to the east by Conrail railroad tracks, to the north by OU1, and to the south by Shepherd Lane. This 66.4 acre area was used to support and supplement the activities of the adjacent site. The facility includes a decommissioned former nuclear engine research and test facility which was housed in Buildings C-west and D, and four large above-ground storage tanks for the storage of diesel and jet fuels. In addition to the above-ground tanks, there were 21 underground storage tanks for the storage of jet and diesel fuels, oils, gasoline, and water. The underground storage tanks have been removed.

The former Air Force Plant 36 is part of a U.S. Air Force Installation Restoration Program (IRP) investigation. Current activities at OU2 include general worker activities associated with industrial activities and with the IRP investigation.

2.2.3 Operable Unit 3

Operable Unit 3 encompasses all of the off-site GE-owned property east of the Conrail railroad tracks with the exception of SWMUs 27 through 31. The three SWMUs included in OU3 were used for disposal of construction debris (SWMU 17 - Reading Road Landfill) and precipitate from the cold lime softening of drinking water (SWMU 18 - Sludge Basin Landfill and SWMU 19 - East Land Farm). There is currently no GEAE Facility-related activity in this area. A single residence is located within OU3. This residence is occupied by a farmer whose fields may, at times, include portions of OU3 as shown in Figure 2-2.

2.2.4 Operable Unit 4

Operable Unit 4 includes three active lime precipitation basins and two former lime precipitation basins located east of the Conrail railroad tracks on GE-owned property outside the main Facility.

2.3 Physical Features

A complete description of the meteorology, geology, and hydrogeology of the study area is presented in the Risk Assessment Workplan (Appendix A). This information is summarized below.

Climate/Meteorology - The GE Aircraft Engines facility is subject to climatological and meteorological conditions (*e.g.*, temperature, precipitation, wind speed) which vary widely within a year. The average temperature for the area is 53.7°F with a minimum recorded temperature of -25°F and a maximum recorded temperature of 103°F. The average annual precipitation for the area is 40.82 inches with a range spanning 30 to 58 inches. The mean wind speed for the area is 9.1 mph from the south/southwest direction.

Surface Water - The GE Aircraft Engines Evendale facility is situated in the Mill Creek Valley between the West Fork and Mill Creek (Figure 2-1). The confluence of these two creeks lies approximately 1.5 miles south of the plant and Mill Creek continues flowing south until it empties into the Ohio River at Cincinnati. Facility surface water drainage is accomplished by a series of storm water sewer systems (OBG, 1995a). The water collected in the sewers is generally directed to oil/water separators or to lined or unlined drainage ditches on-site. The storm sewers and ditches eventually discharge to Mill Creek through National Pollution Discharge Elimination Systems (NPDES)-permitted out falls (OBG, 1995a).

Geology - The study area is located in the Mill Creek Valley, which overlies the ancestral valley of the Ohio River. Five primary sedimentary facies exist in the Mill Creek Valley including a surficial formation of interbedded silt, sand and clay; an upper silt and clay formation; an upper fine to coarse sand and gravel formation; a lower silt and clay formation; and a lower, sand and gravel formation directly overlying bedrock (OBG, 1995a).

Groundwater - Three primary hydrogeologic units are present in the Mill Creek Valley: (1) a surficial water-bearing silty sand-clay formation (perched zone); (2) an upper sand and gravel aquifer comprised of the upper sand and gravel formation; and (3) a lower water-bearing sand and gravel aquifer which consists of the lower sand and gravel formation. The three hydrogeologic units in the Mill Creek Valley are separated by continuous layers of silt and clay (OBG, 1995a). Groundwater elevation data indicate that groundwater present in the perched zone follows a convergent pattern of flow oriented in a northeastern to southwestern direction. Groundwater in the perched zone is from I-75 along the western property boundary to the southeast towards the former Air Force Plant 36. The groundwater flow in the upper sand and gravel aquifer is generally towards the southwest. Finally, the groundwater flow in the lower sand and gravel aquifer is to the south-southwest,

consistent with the regional flow pattern which parallels the trend of Mill Creek Valley (OBG, 1995a).

2.4 Regional Water Resources

GE currently obtains process water from the Southwest Ohio Water Company (a private supplier with wells located several miles west of the facility. GE has 6 on-site wells that are used for cooling water and other industrial purposes and three wells are currently active (OBG, 1995a). GE currently obtains drinking water from the City of Cincinnati.

Active municipal well fields operated by the Villages of Lockland and Glendale are located to the north of the GE facility and are hydraulically upgradient (based on site and regional hydrogeology) (OBG, 1995a). All off-site water usage at downgradient locations (hydrologically) utilize the City of Cincinnati water supply (OBG, 1995a). Additional information describing the municipal well fields is provided in the Risk Assessment Work Plan (Appendix A).

Census data indicate that all residents are serviced by public water and sewer systems. Communities within the study area do not specifically restrict the installation of wells; however, several municipalities require the use of publicly supplied water and all of the surrounding communities are supplied with public water. The city of Glendale requires all residential dwellings to be supplied with water from the city water supply (Section 155.04 of Title XV Land Usage). The city of Evendale requires all new subdivisions to install water lines connected to the city water supply. The cities of Lincoln Heights and Sharonville do not have regulations regarding use of municipal water.

A well survey was conducted to determine whether some residents in the vicinity of the facility may use groundwater. Ohio Department of Natural Resources (ODNR) well logs (including located well logs, unlocated well logs, and pre-1953 well logs) were reviewed to identify all wells within 1/2 mile of the GEAE property. A complete list of wells is provided in Table 2-2. Wells identified as being in "questionable areas" could not be located exactly and, therefore, may be within 1/2 mile of the site. The majority of these wells were installed between 1925 and 1960. Since public water is now available it is likely that most, if not all, of these wells are no longer in use. Wells installed by GE and leased to the city of Reading are now closed. Wells installed by the former Wright Aeronautical Corp. (now GEAE) in the 1940s are no longer in service. The current status of other wells is unknown since records are required when a well is drilled but not when it is taken out of service or closed. Only six of the identified wells are potential residential wells (*i.e.*, they are owned by private individuals). These six privately owned wells are listed in Table 2-3. The location of the first five wells is located near Cooper Road between Otterbein Road and Route 42. Exact locations cannot be determined from the well logs. These wells were installed between 1952 and 1963 and this area is currently supplied with potable water by the City of Cincinnati. **However, it is unknown whether these wells are currently used for any purpose.** All five of these wells are cross gradient and across Mill creek from the Facility. Therefore, if these wells are still in use, such use will not result in exposure to site-related contaminants. The sixth well, belonging to Wm. S. Merrel, could not be

located. This well is dry, and therefore does not represent a potential exposure point. Local drilling companies were also contacted to locate any additional wells not documented by the ODNR. A list of companies contacted is provided as Table 2-4. All of the drilling companies contacted reported that all well logs for wells they have drilled were submitted to the ODNR.

2.5 Potential Receptor Identification

A complete receptor identification is presented in the Risk Assessment Workplan (Appendix A). This receptor identification presents the results of a demographic study performed for the General Electric (GE) Aircraft Engines Facility in Evendale, Ohio and surrounding area (the study area) that characterizes land use, population activities, population types and population growth rates using information obtained from county, state and federal sources. The purpose of this study was to identify the types of human activities that occur within the study area and determine how these activities may change in the future based on population growth estimates, zoning regulations and land use opportunities. This information was relied upon to identify potential receptors that may have contact with site-related chemicals and to quantify chemical uptake in the Exposure Assessment (Section 5.0).

Zoning designations within the study area included four designations: (1) residential, (2) commercial, (3) industrial, and (4) open space and public/institutional land. The GE facility is largely surrounded by industrial and commercial parcels of land. From the southern portion of the GE facility to the extreme northern portion of the study area, land usage has been zoned for industrial and commercial. Residential communities exist westward from the facility on the opposite side of Highway 75. The nearest residential zone west of the facility is located approximately 0.2 miles in the City of Lincoln Heights. The nearest residential zone east of the facility is located approximately 0.75 miles in the Village of Evendale. The nearest residential zone south of the facility is located approximately 0.1 miles in the Village of Lockland. No residential zones within the study area exist north of the facility and east of Highway 75.

2.5.1 Determination of Current Land Use

The study area encompasses both urban and rural characteristics within the communities of Evendale, Glendale, Lincoln Heights, Lockland, Reading, Sharonville, Woodlawn, and Wyoming in northwest Hamilton County, Ohio. The study area (approximately 7.24 square miles) consists of four major current land use designations including:

- industrial/commercial areas;
- residential areas;
- forest, field, and wetland areas; and
- agricultural areas (Figure 2-3).

Industrial/Commercial Areas

Approximately 48 % of the land within the study area is currently industrial/commercial land. As shown in Figure 2-3, the majority of land actively used for industrial or commercial purposes is located within the Village of Evendale surrounding and including the GE Facility. Human activities associated with this land use include:

GE Property - Approximately 6,000 employees work on-site in production, managerial, maintenance, and administrative staff positions. Facility operations occur during three shifts daily with the majority of employees working the first shift. The majority of managerial and administrative work is done indoors during a normal 8 hour workday and 40-hour workweek. Some maintenance work is performed outdoors. Thus, human activities performed at the GE facility are expected to involve indoor and outdoor work during a normal 8-hour work day and 40-hour work week.

Non-GE Property - The majority of businesses in the study area are commercial in nature (e.g., machine shops, dry cleaners, auto repair shops, etc.). Thus, much of the non-GE commercial/industrial activity in the study area is expected to involve indoor work during a normal 8-hour workday and 40-hour workweek.

Residential Areas

Approximately 20 % of the land within the study area is currently residential property. As shown in Figure 2-3, the Village of Lockland and the Cities of Lincoln Heights and Reading have the largest residential areas within the study area. The closest residential areas to the GE boundary are located to the west and south of the site. One residence within the GE property boundary (in OU3) is owned by GE and leased to a farmer by GE on a yearly basis.

Forest/Field/Wetland Areas

Approximately 23% of the study area is currently undeveloped (i.e., forests, fields and wetlands) (Figure 2-3). Human activity associated with such land is likely to be limited to recreational activities such as hiking, nature observation, etc.

Agricultural Areas

About 2% of the land within the study area is currently used for agricultural purposes. A total of 3 plots of land used for agricultural purposes were identified in the study area. One agricultural field is located east of the Facility and can be seen from Glendale - Milford Road. A second agricultural field is located on a plot of land stretching north from Cooper Road between two residential neighborhoods and is associated with a historic working farm open to the public with access from Reading Road. A third agricultural field is leased by a farmer from GE and is located on GE property between Formica Inc. and GE (in OU3). Activities associated with the production of such crops is expected to be seasonal (spring, summer, and fall) and primarily associated with outdoor work during hours of daylight (i.e., 8 to 14 hours/day).

Educational Areas

A total of 16 schools and child care facilities are located within the one-mile study area in the Villages of Evendale, Glendale, Lockland, and Woodlawn, and the Cities of Lincoln Heights, Reading, Sharonville, and Wyoming.

Communal Areas

Communal areas include areas where a large number of people gather for various reasons and activities (e.g., community centers, libraries, churches). Also included in this category are areas used for the public good such as community administration centers and police and fire stations. Communal areas within the study area include 8 police/fire stations, 4 city halls/administration centers/community centers, and approximately 40 churches and libraries.

Recreational Areas

Approximately 4% of the land within the study area is currently used for outdoor recreational activities. There are a total of 19 parks located within the study area (Figure 2-3). Fifteen of these are neighborhood parks in the Village of Lockland and the Cities of Reading, and Wyoming. The two remaining recreational areas are miniature golf courses and driving ranges in Evendale and Sharonville. All of the activities associated with these areas are expected to occur outdoors and are primarily limited to fair weather conditions (i.e., dry, warm weather).

2.5.2 Plausible Future Land Use

The purpose of this section is to evaluate the likelihood of current land use within the study area changing due to population growth, zoning changes, property transactions, and site activities.

On-Site (GE-Facility)

The type of activities and land use for most of the facility is not expected to change significantly in the next several years. If land use modifications are desired in the future, the new use designations will be evaluated with respect to potential environmental risks and altered as necessary. Therefore, it is assumed that future on-site populations will consist of employees working at the GE facility. Due to the regulatory constraints for land use and operations at the site, it is assumed that security of the entire GE facility will be maintained to prevent public access and trespassing by unauthorized persons (OBG, 1995a).

Off-Site

Based upon local zoning regulations, a consideration of current land use, projected population growth estimates, future development plans, and personal communication with city officials, the most plausible future uses for the majority of non-GE-owned land within the study area is expected to remain unchanged (Section 3.5). Therefore, off-site land uses are expected to remain as presently zoned (commercial, industrial, and residential).

TABLE 2-1
LIST OF SWMUs AND AREAS OF CONCERN IN EACH OPERABLE UNIT
GEAE EVENDALE FACILITY
(Page 1 of 6)

SWMU	
No.	Name
<u>Operable Unit 1</u>	
1	Bldg. 519 Hazardous Waste Container Storage Area
2	Bldg. 509 Hazardous Waste Container Storage Area
3	Former Bldg. 509 Underground Waste Oil Tank
4	Bldg. 509 Waste Oil Tank
5	Bldg. 509 Waste 1,1,1 TCA Tank
6	Bldg. 509 Sump
7	Rainwater Drum Storage Area
8	Temporary Drum Storage Area (Former Bldg. 509)
9	Waste Oil Drum Storage Area
10	BFI Special Waste Storage Container
11	Scrap Metal Storage Bins
12	Drum Crusher Unit
13	Crushed Drum Storage Bin
14	Battery Storage Area
15	Radioactive Waste Storage Area
16	Weigh Station Sump
20	Former North Landfarm
21	Former 508 Sludge Basin
22	Former 508 Sludge Basin
23	Former Bldg. 313 Sludge Drying Bed Site
24	Former Sermetel Basin A
25	Former Sermetel Basin B
26	Active Sermetel Basin and Unloading Station
32	304A Basin
33	405A Basin
34	ECM Basin
35	Facility Chip Bins
36	Chip Transfer Stations
37	Chip Transfer Stations
38	Chip Transfer Stations
39	Chip Transfer Stations
43	Former Paper Collection Area
44	Bldg. 704 Waste Collection Station
45	Fmr. Bldg. 313 Codep Pile (No action if pile analyzed)

TABLE 2-1
LIST OF SWMUs AND AREAS OF CONCERN IN EACH OPERABLE UNIT
GEAE EVENDALE FACILITY
(Page 2 of 6)

SWMU	
No.	Name
47	Former Bldg. 417 Incinerator
48	Bldg. 704 Incinerator
49	Former Bldg. 705 Hazardous Waste Storage Area
50	Former Bldg. 705 Nonhazardous Waste Storage Area
51	Deleted
52	Bldg. 800 Hazardous Waste Drum Storage Area
53	Deleted
54	Asbestos Dumpster
55	Former EMTL Underground Waste Oil Tank
58	Bldg. 421 Fly Ash Storage Tank
59	Ultrafiltration Concentrate Tank
60	Tramp Oil Tank
61	Underground Waste Oil/Fuel Storage Tank 304-7 (old)
62	Underground Waste Oil/Fuel Storage Tank 417-2
63	Underground Waste Oil/Fuel Storage Tank 417-3
64	Underground Waste Oil/Fuel Storage Tank 505-28 (old)
65	Underground Waste Oil/Fuel Storage Tank 507-4
66	Deleted
67	Underground Waste Oil/Fuel Storage Tank 304-7 (new)
68	Underground Waste Oil/Fuel Storage Tank 505-28 (new)
69	Waste Fuel Collection Tank 301-1
70	Waste Fuel Collection Tank 303-2
71	Deleted
73	Titanium Clean Line Alkaline Sludge Collect. System
74	Former 1,1,1 TCA Distillation Site
75	Mobile Corrosive Waste Tank
76	Mobile Corrosive Waste Tank
77	Former Bldg. 415 Electroplating Treatment Basin
78	ECM Sludge Filter Press
79	Former Bldg. 800 Wastewater Pretreatment System
80	Former Ammonia Wastewater Neutralization Site
81	Bldg. 800 Wastewater Pretreatment System
82	Bldg. 800 Wastewater Pretreatment System
83	Bldg. 800 Wastewater Pretreatment System
84	Bldg. 800 Wastewater Pretreatment System

TABLE 2-1
LIST OF SWMUs AND AREAS OF CONCERN IN EACH OPERABLE UNIT
GEAE EVENDALE FACILITY
(Page 3 of 6)

SWMU	
No.	Name
85	Oil/Water Separator 200
86	Oil/Water Separator 301-2
87	Oil/Water Separator 303-1
88	Oil/Water Separator 303-3
89	Oil/Water Separator 304-2
90	Oil/Water Separator 305-1
91	Oil/Water Separator 407-1
92	Oil/Water Separator 417
93	Oil/Water Separator 500-1E
94	Oil/Water Separator 500-1W
95	Oil/Water Separator 500-2
96	Oil/Water Separator 500-4
97	Oil/Water Separator 702
98	Oil/Water Separator 703-1E
99	Oil/Water Separator 703-1W
100	Oil/Water Separator 707-1
105	Waste Oil Sludge Removal Tank (Removed)
107	Acid Neutraliz. System - Bldg. 800 Quality Labs
108	Acid Neutraliz. System - Bldg. 700 Macroetch
109	Acid Neutraliz. System - Bldg. 700 Ti Clean
110	Acid Neutraliz. System - Bldg. 700 Process Room
111	Acid Neutraliz. System - Bldg. 200 Process Room
114	Acid Neutraliz. System - Bldg. 715 ES&Stem
115	Acid Neutraliz. System - Bldg. 700 Development Labs
116	Facility Test Cell Drains
117 (SD-22) ^a	Process Sewer System - Oil/Water Sewer System
118 (SD-23) ^a	Process Sewer System - Sanitary Sewer
119 (SD-24) ^a	Process Sewer System - Stormwater Sewer
120	Process Sewer System - Former Sludge Line
121	Process Sewer System - Waste Sewer
122	Stormwater Pumphouse 422
123	Stormwater Pumphouse 423
124	Stormwater Pumphouse 506
125	Concrete Lined Drainage Ditch - North and East
126	Concrete Lined Drainage Ditch - West

TABLE 2-1
LIST OF SWMUs AND AREAS OF CONCERN IN EACH OPERABLE UNIT
GEAE EVENDALE FACILITY
(Page 4 of 6)

SWMU	
No.	Name
127 (SD-25) ^a	Unlined Drainage Ditch
128	Facility Cyclones
130	Facility Air Scrubbers
131	Laser Drill No. 2 Electrostatic Precipitator
133	Facility Vapor Degreasers (deleted)
134	Kirtsite Foundry
140	Former Lime Sludge Sluiceway
142	Bldg. 800 Machine Sump (Added 1/16/91)
143	Bldg. 800, G1, Chip Transfer Station (Added 7/15/93)
AOC B	Bldg. 300 Fuel Spill
AOC C	507 Underground Tank Farm Spill
AOC E	Bldg. 303 Fuel Spill
AOC F	Bldg. 517 Fuel Spill
AOC H	ECM Brine Tank Spill
AOC J	308 Fuel Farm Spill
AOC K	ATF Waste Oil/Fuel Spill
AOC L	Blg. 304 Fuel Spill
AOC O	Bldg. 703 Fuel Spill No. 1
AOC P	Bldg. 700 Coolant Spill
AOC Q	Bldg. 518 Waste Oil Spill
AOC R	Bldg. 700 Sulfuric Acid Spill
AOC S	Bldg. 307 Jet Fuel Spill
AOC T	Bldg. 703 Fuel Spill No. 2
AOC V	Radioactive Spill Site
AOC W1	Inactive Underground Product Storage Tanks 306-8
AOC W2	Inactive Underground Product Storage Tanks 417-E M-1
AOC W3	Inactive Underground Product Storage Tanks 505-1 to 27
AOC W4	Inactive Underground Product Storage Tanks 507-5, 6, 13, 1
AOC W5	Inactive Underground Product Storage Tanks 700 N-1, M-1
AOC W6	Inactive Underground Product Storage Tanks 703-2
AOC W7	Inactive Underground Product Storage Tanks 703-1 to 4
AOC DS	306 Drum Storage Area
AOC WD	704 Waste Drum Accumulation
AOC LD	Bldg. 700 South Loading Dock
AOC PST	TCE/TCA Product Storage Tanks

TABLE 2-1
LIST OF SWMUs AND AREAS OF CONCERN IN EACH OPERABLE UNIT
GEAE EVENDALE FACILITY
(Page 5 of 6)

SWMU	
No.	Name
-	Perimeter Well Near Lime Precip. Basins
500-4	Underground Storage Tank 500-4
-	Ash Piles Near Lime Precip. Basins
500-3	Underground Storage Tank 500-3
UST 503	503-1 to 503-10 Tank Farm
800-1	Underground Storage Tank 800-1
700-3	Underground Storage Tank 700-3
700-4	Underground Storage Tank 700-4
<u>Operable Unit 2</u>	
40	Former Bldg. H Chip Storage Pad
41	Chip Piles
42 (SS-20) ^a	Former Chip Loading Area
46	Former Bldg. M Incinerator
56	Lime Thickener Tank
57	Lime Thickener Tank
72 (ST-14) ^a	Waste Fuel Collection Tank D-1
101	Oil/Water Separator B-1
102	Oil/Water Separator C-1
103	Oil/Water Separator J-1
104	Oil/Water Separator SFF-1
106	Acid Neutralization System - Bldg. C
112	Acid Neutraliz. System - Bldg. D Plating Line
113	Acid Neutraliz. System - Bldg. D Cleaning Line
129	Thermal Plasma Spray Unit Multiclone
132	Paint Spray Booth Air Pollution Control Equipment
135	Facility Baghouses
136	Well Cuttings Drum Storage Area
137	Well Cuttings Storage Pile
138	Outside PCB Transformer Station Sumps
139	Safety Kleen Units
141 (SD-26) ^a	Gravel Media Coalescing Separator
AOC A (SS-27) ^a	Bldg. P Fuel Spill
AOC D (SS-28) ^a	Bldg. B Fuel Spill No. 1
AOC G (SD-23) ^a	South Fuel Farm Spill No. 1

TABLE 2-1
LIST OF SWMUs AND AREAS OF CONCERN IN EACH OPERABLE UNIT
GEAE EVENDALE FACILITY
(Page 6 of 6)

SWMU No.	Name
AOC I (SD-29) ^a	Bldg. B Fuel Spill No. 2
AOC M	South Fuel Farm Spill No. 2
AOC N	South Fuel Farm Spill No. 3
AOC U (SS-30) ^a	South Fuel Farm Spill No. 4
AOC W8	Inactive Underground Product Storage Tanks B-3, 4
AOC-W9	Inactive Underground Product Storage Tanks C-1 to 3
AOC-W10	Inactive Underground Product Storage Tanks D-1 to 5
<u>Operable Unit 3</u>	
17	Reading Road Landfill
18	Sludge Basin Landfill
19	East Landfarm
<u>Operable Unit 4</u>	
27	Former Lime Precipitate Basin 1
28	Former Lime Precipitate Basin 2
29	Lime Precipitate Basin 3
30	Lime Precipitate Basin 4
31	Lime Precipitate Basin 5

a U.S. Air Force Installation Restoration Program (IRP) number in parentheses.

TABLE 2-2
WELLS LOCATED WITHIN 1/2 MILE RAIDUS OF THE GEAE FACILITY
(Page 1 of 2)

Log Number	Owner	Location
250804(6)	American Cynamid (Formica)	10155 Reading Road, Evandale
250803(7)	American Cynamid (Formica)	10155 Reading Road, Evandale
358267(9)	Formica Corp.	10155 Reading Road, Evandale
207(17)	Fox Paper Co.	Lock St. & Wyoming Ave., Lockland
206(25)	Fox Paper Co.	Lock St. & Cooper Ave, Lockland
67(35)	Fox Paper Co.	
400(36)	Fox Paper Co.	
406(17)	New York Central R.R.	Evendale Rd., Sharonville
560(33)	Pollak Steel Co.	Rt. 50 by-pass, Evendale
358264(34)	Micro Mechanical Finishing Co.	Lockland & Sharon Rd., Sharonville
230001(37)	Maxwell Co.	Rt. 50, Evendale
497764(47)	The Sawbrook Steel Castings Co.	Shepard Ave., Lockland
37453(47)	The Sawbrook Steel Castings Co.	Shepard Lane, Lockland
553(48)	Darling & Co.	Big 4 and Smalley, Lockland
242(50)	Wright Aeronautical Corp.	SW of Water, Lockland
238(51)	Wright Aeronautical Corp.	SW of Water, Lockland
237(52)	Wright Aeronautical Corp.	Foundry Gate Guard House, Lockland
75(53)	Wright Aeronautical Corp.	NW Corner of property, Lockland
74(54)	Wright Aeronautical Corp.	
73(55)	Wright Aeronautical Corp.	
71(56)	Wright Aeronautical Corp.	
72(57)	Wright Aeronautical Corp.	
70(58)	Wright Aeronautical Corp.	
249(59)	Wright Aeronautical Corp.	
252(60)	Wright Aeronautical Corp.	
250(61)	Wright Aeronautical Corp.	
254(62)	Wright Aeronautical Corp.	
251(63)	Wright Aeronautical Corp.	
253(64)	Wright Aeronautical Corp.	
98(71)	City of Reading	Koenig Park, Reading
230003(72)	City of Reading	Columbia Avenue and Koenig
198166(73)	City of Reading	Centenial Park
142780(74)	City of Reading	Reading Wells Field
51741(75)	City of Reading	Reading Wells Field
142795(76)	City of Reading	Reading Wells Field
9931176(77)	International Minerals & Chemical Corp.	Lockland
201948(77)	International Minerals & Chemical Corp.	Lockland
258863	D. Ziccardi	Giddeon Lane
101817(9)	Formica Corporation	Reading Rd., Evendale
179958(9)	Formica Corporation	Reading Rd., Evendale
142764(9)	Formica Corporation	Reading Rd., Evendale
151087	George Duyyer	Cooper Rd & Reading Rd
110167	Oscar Johnston	Cooper Rd & Reading Rd
110168	Al Janney	Cooper Rd & Rt. 42-25
100510	JP Huddlestar	Cooper Rd & Reading Rd
710927	Celotex Corp.	S. Wayne Ave., Lockland
198168	GE Leases to City of Reading	Millcreek
198167	GE Leases to City of Reading	Millcreek

TABLE 2-2
WELLS LOCATED WITHIN 1/2 MILE RAIDUS OF THE GEAE FACILITY
(Page 2 of 2)

Log Number	Owner	Location
360342	Diamond North Corp	Lockland
136751	Valley Steel Products	Jimson Rd., Evendale
179971	City of Wyoming	Municipal Building, Wyoming
179970	City of Wyoming	Municipal Building, Wyoming
230008	City of Wyoming	Service Yard, Wyoming Garage
578(9)	Formica Company	Reading Rd., Evandale
577(9)	Formica Company	Reading Rd., Evandale
36	Phillips Swimming Pool	Ann St. & Hillside, Lockland
233	Wright Aeronautical Corp.	Lockland
272	City of Wyoming	Wyoming
366	Wyoming Water Works	Wyoming
38	Wm. S. Merrel	Reading
37	Wm. S. Merrel Co.	Amity Rd., Reading

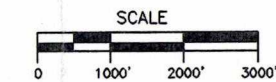
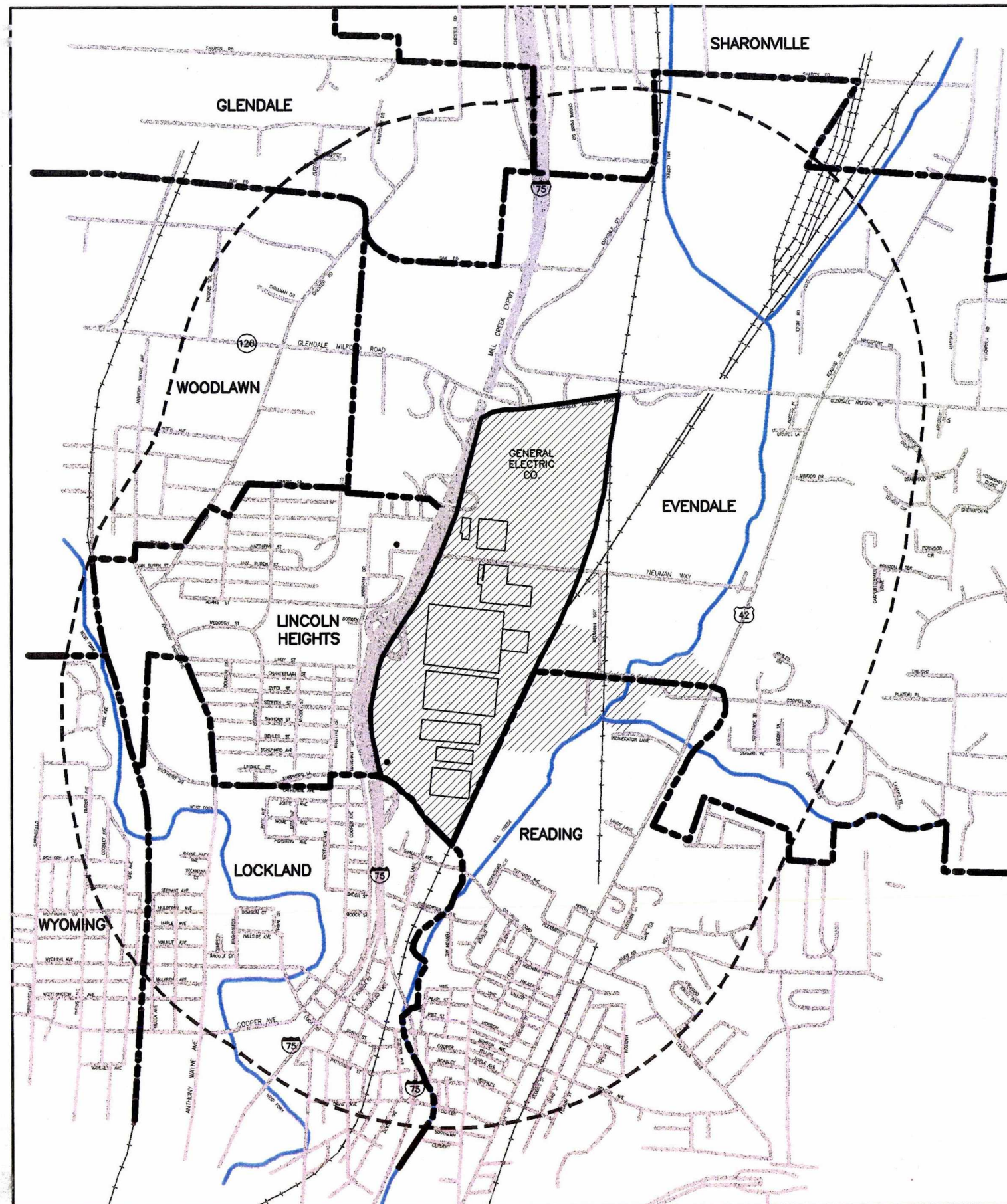
TABLE 2-3
PRIVATELY OWNED WELLS LOCATED WITHIN ONE HALF MILE OF THE
GEAE EVENDALE PROPERTY

Log Number	Owner	Location	Date	Depth to Water	Total Depth of Well
258863	D. Ziccardi	Giddeon Lane	1963	NR	100ft
151087	George Duyyer	Cooper Rd & Reading Rd	1956	NR	85ft
110167	Oscar Johnson	Cooper Rd & Reading Rd	1953	47ft	75ft
110168	Al Janney	Cooper Rd & Rt. 42-25	1953	55ft	76ft
100510	JP Huddleston	Cooper Rd & Reading Rd	1952	NR	100ft
38	Wm. S. Merrel	Reading	1936	Dry	142ft

NR - Not Reported.

TABLE 2-4**DRILLING COMPANIES CONTACTED IN THE CINCINNATI/DAYTON AREA**

Company Name	Phone Number	Address	Contact Person	Comments
Clepper Pete Well Driller	513/752-2836	Cincinnati, Ohio	Receptionist	Yes, they turn all water well logs into ODR
Wilson Well Drilling	937/787-3011	Cambden, Ohio	Receptionist	Yes, they turn all water well logs into ODR
Gregory Vernon Well Dilling	937/382-1845	Wilmington, Ohio	Receptionist	Yes, they turn all water well logs into ODR
Reed Lewis Well Driller	513/738-1396	Ross, Ohio	Driller	Yes, they turn all water well logs into ODR
Barrett Well Drilling	513/746-6178	Franklin, Ohio	Receptionist	Yes, they turn all water well logs into ODR
Hayslip Guy & Son Water Well Drilling	937/783-2064	Blanchester, Ohio	Driller	Yes, they turn all water well logs into ODR
Barnes D.C. Well Drilling & Pumps	937/837-2120	Trotwood, Ohio	Driller	Yes, they turn all water well logs into ODR



LEGEND

- Railroad
- Study Area Boundary
- GEAE Facility Boundary
- GE Aircraft Engine Property
- Surface Water
- Community Boundary

G.E. AIRCRAFT ENGINES FACILITY EVENDALE, OHIO



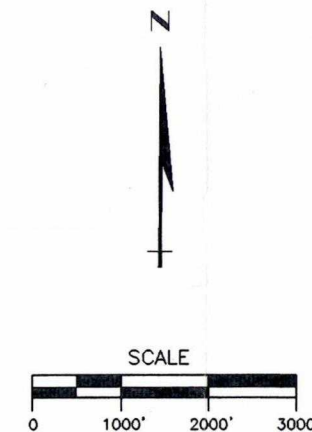
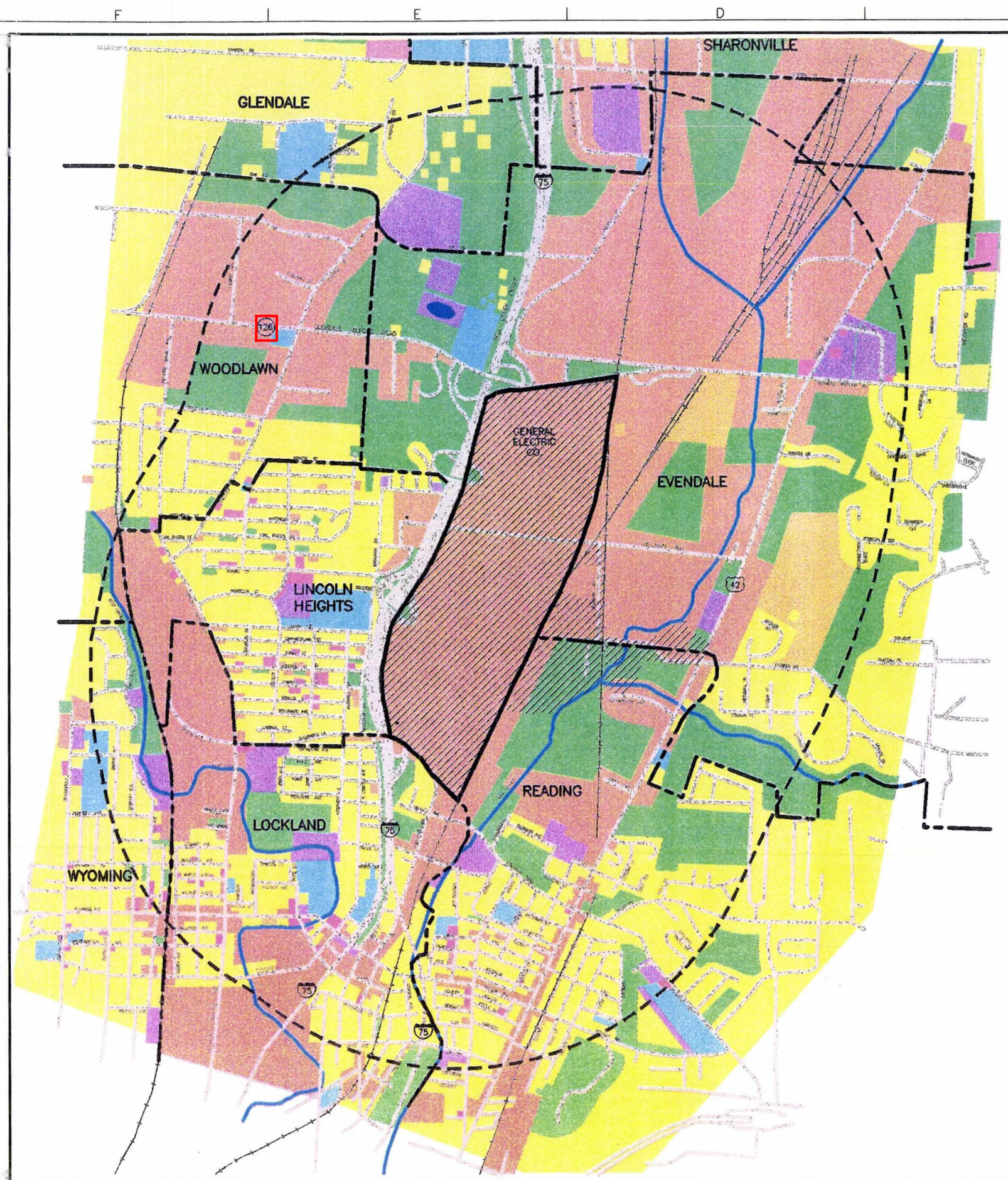
DRWN: TML	DATE: 11-96
CHKD	DATE
APPD	DATE
SCALE	AS SHOWN

STUDY AREA

Filename: R:\3673\3673d002.dwg
Plot File: R:\3673\3673d00.pcp

DRAWING NUMBER
FIGURE 2-1

CHECK PRINT NUMBER
EDITING TIME
TIME
DATE
EDITED BY



LEGEND

- Railroad
- Study Area Boundary
- GEAE Facility Boundary
- GE Aircraft Engine Property

LAND USE

- Agricultural
- Industrial / Commercial
- Communal
- Educational
- Forest / Field / Wetland
- Recreational
- Residential
- Surface Water

G.E. AIRCRAFT ENGINES FACILITY EVENDALE, OHIO



DRWN: TML	DATE: 11-96
CHKD	DATE
APPD	DATE
SCALE	AS SHOWN

CURRENT LAND USE WITHIN THE STUDY AREA

Filename: R:\3673\3673d006.dwg
Plot File: R:\3673\3673d00.pcp

DRAWING NUMBER
FIGURE 2-3

3.0 DATA EVALUATION

The purpose of this section is to review available environmental data, identify appropriate risk assessment data sets, identify chemicals of interest (COIs), and calculate summary statistics and exposure point concentrations of COIs for the four operable units at the GEAE Evendale site:

- Operable Unit 1 Production area north of the former Air Force Plant 36 and west of the Main Drainage Ditch;
- Operable Unit 2 Former Air Force Plant 36;
- Operable Unit 3 SWMUs 17-19 (Reading Road Construction Debris Area, Sludge Basin Landfill, East Landfarm); and
- Operable Unit 4 SWMUs 27-31 (Lime Precipitation Basins).

As discussed in Section 2.0, the site is divided into these four operable units for risk assessment purposes based on the types of exposure expected to occur as well as geographical and land use considerations.

Section 3.1 presents an overview of the data evaluation methodology that is used to prepare the HHRA for the GEAE Evendale site (Figure 2-2). Available data are summarized in Section 3.2 and appropriate data sets are identified in Section 3.3. A summary of the data evaluation process for each of the four operable units at the GEAE Evendale site is presented in Section 3.4.

3.1 Methodology

Preliminary chemicals of interest (PCOIs) were identified and reported in the approved Work Plan (ChemRisk, 1997) for sitewide soil, sediment, and perched, upper sand and gravel, and lower sand and gravel groundwater (Appendix A). The maximum detected concentrations in each medium were compared to appropriate background levels and health-protective benchmarks to identify chemicals to be evaluated in this quantitative HHRA. Since the Work Plan was submitted, additional data were available from ongoing sampling and refinements to the chemical selection process as noted in this HHRA. Therefore, the identification of PCOIs is updated in this HHRA to define the risk assessment data sets. The same methodology used in the Work Plan to identify PCOIs (*i.e.*, comparisons of maximum detected concentrations in sitewide media to background levels and health-protective benchmarks) is re-applied to the risk assessment data sets to identify the PCOIs for this HHRA (Tables 3-1 through 3-5). The updates to the PCOI list for sitewide media are summarized below.

Medium

Work Plan PCOIs vs. HHRA PCOIs

Soil (direct contact)	No changes
Soil (protection of groundwater)	Five chemicals (aluminum, Aroclor-1254, cobalt, methyl ethyl ketone, thallium) added and three chemicals (acetone, calcium, zinc) eliminated as PCOIs
Sediment	One chemical (ethylbenzene) added as a PCOI
Perched Groundwater	No changes
Upper Sand & Gravel Groundwater	Two chemicals (cadmium, chromium) added as PCOIs
Lower Sand & Gravel Groundwater	One chemical (total petroleum hydrocarbons) eliminated as a PCOI

The PCOIs identified on a sitewide basis are used as the starting point for the data evaluation process presented in this HHRA. Risk assessment data sets are divided into data sets for each operable unit (see Section 3.3) and PCOIs are evaluated for each medium within an operable unit. The methodology used for data evaluation is discussed briefly below.

3.1.1 Identification of Risk Assessment Data Sets

Environmental data for the GEAE Evendale site are available from several sources including historical investigations, the RFI, a U.S. Geological Survey (USGS) study, interim measures and other post-RFI investigations. In general, RFI data are used to support the HHRA since they are more complete and have undergone validation/verification. Data from other sources are used to supplement RFI data, where appropriate. The decision to include a data set in the HHRA is determined by evaluating the appropriateness of several factors: (1) the list of analytical parameters, (2) the analytical methods and corresponding detection limits, (3) the date of sample collection, and (4) the overall quality of the data.

The risk assessment data sets are categorized according to sample location, sample depth, and sample type for the purpose of characterizing chemical distribution.

3.1.2 Identification of Chemicals of Interest

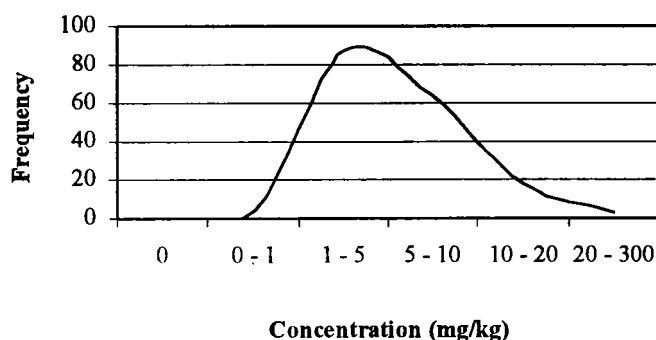
Chemicals of interest are identified for each exposure medium based on comparisons to natural background levels and health-based benchmarks. Final approval of the Work Plan from USEPA was made without consideration of frequency of detection evaluations which would eliminate those chemicals detected in media at frequencies of 5% or less.

Background Comparison Evaluation

A statistical approach is used to determine if concentrations of naturally-occurring (*i.e.*, inorganic) chemicals in area-specific media are elevated above background concentrations. Local background data for soil and groundwater provided in the RFI (OBG, 1995) are used to calculate upper background levels or UBLs (ChemRisk, 1997). Maximum detected concentrations of potentially site-related inorganic chemicals are compared to UBLs to determine their relevance in this quantitative assessment. Since site-specific background data are not collected for sediment, UBLs for soil are used to evaluate site sediment data. UBLs calculated for soil are presented in Table 3-6. UBLs for perched, upper sand and gravel, and lower sand and gravel groundwater are presented in Tables 3-7 through 3-9.

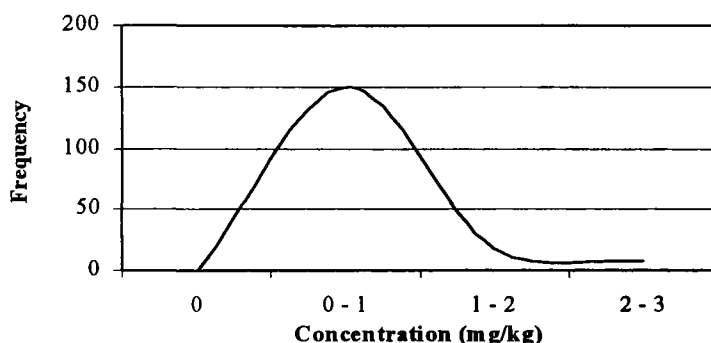
Special consideration is given to the two carcinogenic inorganic chemicals detected at the site (arsenic and beryllium). Since background concentrations can vary considerably, even across the state, site-related concentrations of arsenic and beryllium are also compared to concentrations in Ohio farm soil (Cox and Colvin, 1996) to determine whether or not site-related concentrations present risks that are truly above background-related risks. The concentrations of arsenic in Ohio farm soil range from 0.5 to 56 mg/kg (Cox and Colvin, 1996). As shown below, 99.4% of arsenic measurements for soil at the site (*i.e.*, 175 out of 176) fall below the maximum Ohio farm soil concentration. The maximum concentrations of arsenic in Operable Units 1, 2, and 3 soil are 24, 4.4, and 18 mg/kg, respectively. Since these concentrations fall within the Ohio farm soil range, arsenic is not a concern at these areas. The maximum concentration of arsenic in OU 4 soil (230 mg/kg) is the only measurement which does not fall within the Ohio farm soil range, and is therefore, evaluated further (see Section 6.4).

FREQUENCY DISTRIBUTION - ARSENIC IN SOIL



The concentrations of beryllium in Ohio farm soil range from 0.1 to 3.2 mg/kg (Cox and Colvin, 1996). As shown below, all concentrations of beryllium in soil at the site fall below the Ohio farm soil maximum concentration. The maximum concentrations of beryllium in Operable Units 1, 2, 3, and 4 soil are 3, 0.96, 2.7, and 2.8 mg/kg, respectively. Since these concentrations all fall within the Ohio farm soil range, beryllium is not a concern at these areas.

FREQUENCY DISTRIBUTION - BERYLLIUM IN SOIL



Health-Based Benchmark Comparison Evaluation

A comparison to health-based benchmarks is the second step in the COI selection process. For each operable unit, maximum detected concentrations of site-related chemicals in soil are compared to preliminary remediation goals (PRGs) for industrial soil (USEPA, 1996a). Since PRGs are not available for sediment, maximum detected concentrations in sediment are also compared to PRGs for industrial soil. For each aquifer within an operable unit, maximum detected concentrations of site-related groundwater chemicals are compared to maximum contaminant levels (MCLs) for drinking water (USEPA, 1996c), where available, or PRGs for tap water (USEPA, 1996a). Groundwater at the site is not utilized for drinking purposes and, therefore, this comparison is for screening purposes only. Health-based benchmarks for soil and groundwater are presented in Tables 3-10 and 3-11, respectively.

3.1.3 Calculation of Summary Statistics and Exposure Point Concentrations

Summary statistics (mean, standard deviation, and 95% upper confidence limit) are generated for each COI in each exposure medium (*i.e.*, soil, sediment, and perched groundwater). Based on temporal and spatial considerations (see Section 5.0), upper and lower sand and gravel groundwater data are presented for characterization purposes only. Therefore, summary statistics and exposure point concentrations are not calculated for these media.

Prior to generating summary statistics, sample duplicates are averaged. The averaging of duplicates for data reduction purposes is in accordance with the RFI Guidance (USEPA, 1989f), since "...this removes bias from the overall mean." This guidance also recommends that for data reduction purposes "all data should be reported." Nondetect values are included using one half the detection limit (USEPA, 1989a). In addition, estimated detects (*i.e.*, "J" qualified) are considered true detects. The arithmetic mean, standard deviation, and 95% upper confidence limit (UCL) concentrations are determined for each COI in each medium evaluated as described below.

The arithmetic mean and standard deviation are calculated according to the following equations:

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

$$SD = \left[\left(\frac{1}{n-1} \right) * \sum_{i=1}^n (x_i - \bar{x})^2 \right]^{1/2}$$

where:

SD = arithmetic standard deviation;
 n = number of samples;
 \bar{x} = arithmetic mean concentration; and
 x_i = result for sample i.

For each COI, a 95% UCL of the mean is calculated according to the following equations based on the assumption that the chemical concentrations are normally or lognormally distributed.

Assuming Normality

$$UCL = \bar{x} + t_{0.95} * \frac{SD}{\sqrt{n}}$$

where:

\bar{x} = the arithmetic mean concentration;
 $t_{0.95}$ = statistic for the student's t-distribution, value dependent on the probability (0.95) and degrees of freedom (n-1) specified;
 SD = the arithmetic standard deviation; and
 n = number of samples.

Assuming Lognormality

$$UCL = e^{\left(\bar{x}_t + 0.5 * SD_t^2 + \frac{SD_t * H}{\sqrt{n-1}} \right)}$$

where:

e = constant (base of the natural log, equal to 2.718);
 \bar{x}_t = arithmetic mean of the natural log-transformed concentrations;
 SD_t = standard deviation of the natural log-transformed concentrations;
 H = H-statistic value dependent on the probability (0.95), degrees of freedom (n-1), and SD_t specified; and
 n = number of samples.

For chemicals identified as COIs, the summary statistics described above are used to generate exposure point concentrations (EPCs) for use in the risk assessment according to the following approach.

- The underlying distribution of concentration values is determined for each COI in each medium as being normal, lognormal, or undefined using the

D'Agostino-Pearson K^2 test (D'Agostino *et al.*, 1990), which examines statistics for skewness and kurtosis. This test requires a minimum of 8 samples (preferably >20) of which more than one half should be actual detected concentrations. In cases where the D'Agostino-Pearson K^2 test could not be used due to small sample size or a large number of nondetect values, the data distribution was identified as not determined and assumed to be lognormal (USEPA, 1992e). The results of the normality testing for all COIs are presented in Appendix B.

- For COIs determined to be normally distributed, the 95% UCL assuming normality or the maximum detected concentration (whichever is lower) is used to evaluate the reasonable maximum exposure (RME) scenarios.
- For COIs with distributions that were lognormal, undefined, or not determined, the 95% UCL assuming lognormality or the maximum detected concentration (whichever is lower) is used to evaluate the RME scenarios.
- In accordance with USEPA's guidance for determining the concentration term (USEPA, 1992e), the arithmetic mean concentration or the maximum detected concentration (whichever is lower) is used as the exposure point concentration for the most likely exposure (MLE) evaluation.

However, in certain cases (*i.e.*, for a lognormal distribution with a large number of samples and high variability), the 95% UCL concentration calculated for the RME evaluation is less than the arithmetic mean (MLE EPC). An alternative methodology was used to determine the MLE concentration in these instances. Specifically, the best estimate of the mean (BEM) is used in place of the arithmetic mean, as calculated below:

$$BEM = e^{(\bar{x}_t + 0.5 * SD_t^2)}$$

where:

- e = constant (base of the natural log, equal to 2.718);
- \bar{x}_t = arithmetic mean of the natural log-transformed concentrations; and
- Sd_t = standard deviation of the natural log-transformed concentrations.

Since the BEM, by definition, is always lower than the 95% UCL (lognormal), the modified MLE exposure point concentration is always lower than the RME exposure point concentration.

This approach ensures that the HHRA is consistent with USEPA guidance regarding the concentration term (USEPA, 1992e).

3.2 Summary of Available Data

Environmental data for the GEAE Evendale site are available from historical investigations, the RFI, and post-RFI investigations.

3.2.1 Historical Data

Historical data are available from investigations that were conducted at the GEAE Evendale site prior to the RFI.

- A preliminary assessment of groundwater conditions at the GE Evendale Plant (Geraghty and Miller, 1986).
- A Phase II investigation of hydrogeologic conditions at the GE Evendale Plant (Geraghty and Miller, 1987).
- A hydrogeologic investigation of the former Air Force Plant 36 (Geraghty and Miller, 1988).

Since RFI and post-RFI data are considered adequate and more current, historical data are not used in the HHRA.

3.2.2 RFI Data

Media sampled at the site during the RFI include surface and subsurface soil, sediment, and groundwater. RFI samples collected between April 1990 and June 1994 were analyzed for organic and inorganic constituents in accordance with the approved work plans. For a complete discussion of sampling activities, refer to the RFI (OBG, 1995). A brief summary of the data collected during the RFI is presented below.

Soil

A total of 439 surface and subsurface soil samples were collected from 240 locations (Figure 3-1). A total of 68 surface soil samples were collected at depths ranging from zero to two feet. Subsurface soil samples were collected at depths ranging from two to 30 feet.

Sediment

Twenty-nine sediment samples were collected from 29 locations in the Process Sewer System (SWMUs 117, 118, 119), the Storm Water Pump House Sumps (SWMUs 122, 123, 124), the Gravel-Coalescing Oil/Water Separator (SWMU 141), Oil/Water Separator 500-1 and the Main Drainage Ditch (SWMU 127) (Figure 3-1).

Groundwater

A total of 175 groundwater samples were collected from 99 monitoring wells (Figure 3-2). Seventy-five samples were collected from 55 perched aquifer wells, 57 samples were collected from 22 upper sand and gravel aquifer wells, and 43 samples were collected from 22 lower sand and gravel aquifer wells.

3.2.3 Post-RFI Data

This section identifies more recent soil and groundwater data that are included in the HHRA.

Groundwater Data

Groundwater data from post-RFI investigations that are included in the HHRA groundwater data sets are summarized below.

- The USGS (1994) collected 20 groundwater (six perched, seven upper sand and gravel, seven lower sand and gravel) samples during June 1994 from wells at the downgradient perimeter of the former Air Force Plant 36. Samples were analyzed for select volatile organic compounds.
- Two samples were collected each month from one perched and one upper sand and gravel groundwater monitoring well during October through December 1996 (a total of six samples) in conjunction with the groundwater treatment occurring at the former Air Force Plant 36 (IT Corp., 1997). Samples were analyzed for volatile organic compounds and field parameters.
- Five groundwater (one perched, two upper sand and gravel, two lower sand and gravel) samples were collected during December 1996. Samples were analyzed for inorganic and organic compounds. An additional nine groundwater samples (one perched, eight upper sand and gravel) were collected in November 1997 and analyzed for volatile organic compounds.
- Thirteen groundwater (seven upper sand and gravel, six lower sand and gravel) samples were collected from eight existing and five new monitoring wells at the former Plant 36 during January 1997 (Earth Tech, 1997). All samples were analyzed for volatile organic compounds. Two samples were also analyzed for semi-volatile organic compounds.

Soil Data

Soil data from post-RFI investigations that are included in the HHRA soil data sets are summarized below.

- Five confirmatory soil samples were collected at depths ranging from 4 to 16 feet from two locations during December 1993 in conjunction with the operation of the soil vapor extraction (SVE) system at Building 301 (ETG, 1994). Samples were analyzed for benzene, toluene, ethylbenzene, xylenes, and total petroleum hydrocarbons.
- Twenty-four confirmatory soil samples were collected during November 1995 in conjunction with the SVE systems at Building 306 and Test Cell 46 (OBG, 1996). One surface sample was collected at a depth of zero to two feet and 14 subsurface samples were collected at depths ranging from 2 to 18 feet from five locations at Building 306. Nine subsurface samples were collected at depths ranging from 4 to 18 feet from three locations at Test Cell 46. Samples were analyzed for select volatile organic compounds, lead, and total petroleum hydrocarbons.

3.3 Identification of Appropriate Data Sets

This section identifies the data sets that were developed to characterize the chemical distribution in relevant media at the site. The uncertainties associated with the use of these data are discussed in Section 6.0. Based on a review of available data and the conceptual site model developed in the Exposure Assessment (Section 5.0), the following media are identified as specific risk assessment data sets for quantifying potential exposures.

Operable Unit 1:

- (1) Total Soil (zero to 22 feet);
- (2) Surface Soil (zero to two feet);
- (3) Sediment; and
- (4) Groundwater.

Operable Unit 2:

- (1) Total Soil (zero to 30 feet);
- (2) Surface Soil (zero to two feet);
- (3) Sediment; and
- (4) Groundwater.

Operable Unit 3:

- (1) Total Soil (zero to 28 feet);
- (2) Surface Soil (zero to two feet); and
- (3) Groundwater.

Operable Unit 4:

- (1) Total Soil (zero to 14 feet);
- (2) Surface Soil (zero to two feet); and
- (3) Groundwater.

3.4 Identification of Chemicals of Interest

Chemicals of interest are identified for each medium within an operable unit using the methodology presented in Section 3.1. The results of the COI identification process for the site are summarized below.

3.4.1 Operable Unit 1

Operable Unit 1 includes the production area north of the former Air Force Plant 36 and west of the Main Drainage Ditch (Figure 2-2).

3.4.1.1 Total Soil

The Operable Unit 1 total soil data set consists of 354 samples collected at depths ranging from zero to 22 feet from 177 locations (Table 3-12, Figure 3-1). This data set is defined for the evaluation of potential human exposures to Operable Unit 1 soil during potential excavation activities as described in Section 5.0. Fifteen PCOIs are identified in Operable Unit 1 total soil, including ten organic compounds and five inorganic compounds (Table 3-12). A summary of the results of the COI selection process for Operable Unit 1 total soil is presented in Figure 3-3.

Maximum detected concentrations of inorganic PCOIs in Operable Unit 1 total soil are compared to UBLs for soil. No PCOIs are eliminated from further consideration based on a comparison to UBLs (Table 3-13, Figure 3-3). As discussed in Section 3.1.2, concentrations of arsenic and beryllium are also compared to Ohio farm soil levels. Concentrations of arsenic and beryllium in Operable Unit 1 total soil are plotted and compared to background levels in Figures 3-4 and 3-5, respectively. These two PCOIs are eliminated from further consideration since concentrations are within the ranges for Ohio farm soil and do not appear to be associated with a release from a SWMU (Table 3-13, Figure 3-3). Two additional PCOIs are eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-14, Figure 3-3).

A total of 11 chemicals are identified as COIs in Operable Unit 1 total soil, including two inorganic compounds (manganese and nickel) and nine organic compounds [Aroclor-1248, Aroclor-1254, Aroclor-1260, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, total petroleum hydrocarbons, trichloroethene, and vinyl chloride] (Figure 3-3). The exposure point concentrations for COIs in Operable Unit 1 total soil are identified in Table 3-15.

3.4.1.2 Surface Soil

The Operable Unit 1 surface soil data set consists of 42 samples collected at depths ranging from zero to two feet from 42 locations (Table 3-16, Figure 3-1). This data set is defined for the evaluation of potential human exposures to Operable Unit 1 surface soil as described in Section 5.0. Eleven PCOIs are identified in Operable Unit 1 surface soil, including seven organic compounds and four inorganic compounds (Table 3-16). A summary of the results of the COI selection process for Operable Unit 1 surface soil is presented in Figure 3-6.

Maximum detected concentrations of inorganic PCOIs in Operable Unit 1 surface soil are compared to UBLs for soil. One inorganic PCOI is eliminated from further consideration based on a comparison to UBLs (Table 3-17, Figure 3-6). As discussed in Section 3.1.2, concentrations of arsenic are also compared to Ohio farm soil levels. Concentrations of arsenic in Operable Unit 1 surface soil are plotted and compared to background levels in Figure 3-7. This PCOI is eliminated

from further consideration since concentrations are within the ranges for Ohio farm soil and do not appear to be associated with a release from a SWMU (Table 3-17, Figure 3-6). Four additional PCOIs are eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-18, Figure 3-6).

A total of five chemicals are identified as COIs in Operable Unit 1 surface soil, including one inorganic compound (manganese) and four organic compounds [Aroclor-1248, benzo(a)pyrene, total petroleum hydrocarbons, and trichloroethene] (Figure 3-6). The exposure point concentrations for COIs in Operable Unit 1 surface soil are identified in Table 3-19.

3.4.1.3 Sediment

The Operable Unit 1 sediment data set consists of four samples collected from four locations (Table 3-20, Figure 3-1). This data set is defined for the evaluation of potential human exposures to Operable Unit 1 sediment as described in Section 5.0. Seven PCOIs are identified in Operable Unit 1 sediment, including four organic compounds and three inorganic compounds (Table 3-20). A summary of the results of the COI selection process for Operable Unit 1 sediment is presented in Figure 3-8.

Maximum detected concentrations of inorganic PCOIs in Operable Unit 1 sediment are compared to UBLs for soil. Two inorganic PCOIs are eliminated from further consideration based on a comparison to UBLs (Table 3-21, Figure 3-8). One additional PCOI is eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-22, Figure 3-8).

A total of four organic chemicals (benzene, ethylbenzene, toluene, and xylenes) are identified as COIs in Operable Unit 1 sediment (Figure 3-8). The exposure point concentrations for COIs in Operable Unit 1 sediment are identified in Table 3-23.

3.4.1.4 Groundwater

The Operable Unit 1 groundwater data set consists of 64 samples collected from 47 monitoring wells (Figure 3-2). COIs are identified for total soil (protection of groundwater) as well as for each aquifer; however, exposure point concentrations are only calculated for perched groundwater, as discussed in Section 3.1.3.

Total Soil (Protection of Groundwater)

The Operable Unit 1 total soil data set consists of 354 samples collected at depths ranging from zero to 28 feet from 176 locations (Table 3-24, Figure 3-1). Twenty-six PCOIs, including 15 organic compounds and 11 inorganic compounds, are identified in Operable Unit 1 total soil based on protection of groundwater (Table 3-24). Maximum detected concentrations of inorganic PCOIs in Operable Unit 1 total soil are compared to UBLs for soil. One PCOI is eliminated from further consideration based on a comparison to UBLs (Table 3-25, Figure 3-9). As discussed in Section 3.1.2, concentrations of arsenic are also compared to Ohio farm soil levels. Concentrations of arsenic in Operable Unit 1 total soil are plotted and compared to background levels in Figure 3-4. This PCOI

is eliminated from further consideration since concentrations are within the ranges for Ohio farm soil and do not appear to be associated with a release from a SWMU (Table 3-25, Figure 3-9). Three additional PCOIs are eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-26, Figure 3-9). A total of 21 chemicals are identified as COIs in Operable Unit 1 total soil for the protection of groundwater, including eight inorganic chemicals and 13 organic chemicals (Figure 3-6).

Perched Groundwater

The Operable Unit 1 perched groundwater data set consists of 49 samples collected from 38 monitoring wells (Table 3-27, Figure 3-2). Twenty-two PCOIs are identified in Operable Unit 1 perched groundwater, including 18 organic compounds and four inorganic compounds (Table 3-27). A summary of the results of the COI selection process for Operable Unit 1 perched groundwater is presented in Figure 3-10.

Maximum detected concentrations of inorganic PCOIs in Operable Unit 1 perched groundwater are compared to UBLs for perched groundwater. One PCOI is eliminated from further consideration based on a comparison to UBLs (Table 3-28, Figure 3-10). Two additional PCOIs are eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-29, Figure 3-10).

A total of 19 chemicals are identified as COIs in Operable Unit 1 perched groundwater (Figure 3-10):

<u>Inorganics</u>	<u>Organics</u>	
arsenic	Aroclor-1242	n-nitrosodiphenylamine
chromium	Aroclor-1248	tetrachloroethene
nickel	benzene	total petroleum hydrocarbons
	bis(2-ethylhexyl)phthalate	1,1,1-trichloroethane
	1,2-dichloroethane	1,1,2-trichloroethane
	1,1-dichloroethene	trichloroethene
	1,2-dichloroethene	vinyl acetate
	cis-1,2-dichloroethene	vinyl chloride

The exposure point concentrations for COIs in Operable Unit 1 perched groundwater are identified in Table 3-30.

Upper Sand and Gravel Groundwater

The Operable Unit 1 upper sand and gravel groundwater data set consists of eight samples collected from four monitoring wells (Table 3-31, Figure 3-2). Fifteen PCOIs are identified in Operable Unit 1 upper sand and gravel groundwater, including 12 organic compounds and three inorganic compounds (Table 3-31). Maximum detected concentrations of inorganic PCOIs in Operable Unit 1 upper sand and gravel groundwater are compared to UBLs for upper sand and gravel groundwater. No PCOIs are eliminated from further consideration based on a comparison to UBLs (Table 3-32, Figure 3-11). Five PCOIs are eliminated from further consideration based on a comparison to health-

based benchmarks (Table 3-33, Figure 3-11). A total of ten chemicals are identified as COIs in Operable Unit 1 upper sand and gravel groundwater, including three inorganic chemicals and seven organic chemicals (Figure 3-11).

Lower Sand and Gravel Groundwater

The Operable Unit 1 lower sand and gravel groundwater data set consists of seven samples collected from five monitoring wells (Table 3-34, Figure 3-2). Five PCOIs are identified in Operable Unit 1 lower sand and gravel groundwater, including three organic compounds and two inorganic compounds (Table 3-34). Maximum detected concentrations of inorganic PCOIs in Operable Unit 1 lower sand and gravel groundwater are compared to UBLs for lower sand and gravel groundwater. No PCOIs are eliminated from further consideration based on a comparison to UBLs (Table 3-35, Figure 3-12). Two PCOIs are eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-36, Figure 3-12). A total of three chemicals are identified as COIs in Operable Unit 1 lower sand and gravel groundwater, including one inorganic chemical and two organic chemicals (Figure 3-12).

3.4.2 Operable Unit 2

Operable Unit 2 includes the former Air Force Plant 36 located in the southern portion of the site (Figure 2-2).

3.4.2.1 Total Soil

The Operable Unit 2 total soil data set consists of 73 samples collected at depths ranging from zero to 30 feet from 32 locations (Table 3-37, Figure 3-1). This data set is defined for the evaluation of potential human exposures to Operable Unit 2 soil during potential excavation activities as described in Section 5.0. Eight PCOIs are identified in Operable Unit 2 total soil, including three organic compounds and five inorganic compounds (Table 3-37). A summary of the results of the COI selection process for Operable Unit 2 total soil is presented in Figure 3-13.

Maximum detected concentrations of inorganic PCOIs in Operable Unit 2 total soil are compared to UBLs for soil. Five inorganic PCOIs are eliminated from further consideration based on a comparison to UBLs (Table 3-38, Figure 3-13). One additional PCOI is eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-39, Figure 3-13).

Two organic chemicals (benzene and total petroleum hydrocarbons) are identified as COIs in Operable Unit 2 total soil (Figure 3-13). The exposure point concentrations for COIs in Operable Unit 2 total soil are identified in Table 3-40.

3.4.2.2 Surface Soil

The Operable Unit 2 surface soil data set consists of eight samples collected at depths ranging from zero to two feet from eight locations (Table 3-41, Figure 3-1). This data set is defined for the evaluation of potential human exposures to Operable Unit 2 surface soil as described in Section 5.0.

Two organic PCOIs are identified in Operable Unit 2 surface soil (Table 3-41). A summary of the results of the COI selection process for Operable Unit 2 surface soil is presented in Figure 3-14.

One PCOI is eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-42, Figure 3-14).

One organic chemical (total petroleum hydrocarbons) is identified as a COI in Operable Unit 2 surface soil (Figure 3-14). The exposure point concentrations for total petroleum hydrocarbons in Operable Unit 2 surface soil are identified in Table 3-43.

3.4.2.3 Sediment

The Operable Unit 2 sediment data set consists of 25 samples collected from 25 locations (Table 3-44, Figure 3-1). This data set is defined for the evaluation of potential human exposures to Operable Unit 2 sediment as described in Section 5.0. Seven PCOIs are identified in Operable Unit 2 sediment, including four organic compounds and three inorganic compounds (Table 3-44). A summary of the results of the COI selection process for Operable Unit 2 sediment is presented in Figure 3-15.

Maximum detected concentrations of inorganic PCOIs in Operable Unit 2 sediment are compared to UBLs for soil. No inorganic PCOIs are eliminated from further consideration based on a comparison to UBLs (Table 3-45, Figure 3-15). As discussed in Section 3.1.2, concentrations of arsenic are also compared to Ohio farm soil levels. Concentrations of arsenic in Operable Unit 2 sediment are plotted and compared to background levels in Figure 3-16. This PCOI is eliminated from further consideration since concentrations are within the ranges for Ohio farm soil and do not appear to be associated with a release from a SWMU (Table 3-45, Figure 3-15). Two additional PCOIs are eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-46, Figure 3-15).

A total of four chemicals are identified as COIs in Operable Unit 2 sediment, including two inorganic chemicals (lead and manganese) and two organic chemicals (benzene and xylenes) (Figure 3-15). The exposure point concentrations for COIs in Operable Unit 2 sediment are identified in Table 3-47.

3.4.2.4 Groundwater

The Operable Unit 2 groundwater data set consists of 105 samples collected from 46 monitoring wells (Figure 3-2). COIs are identified for total soil (protection of groundwater) as well as for each aquifer; however, exposure point concentrations are only calculated for perched groundwater, as discussed in Section 3.1.3.

Total Soil (Protection of Groundwater)

The Operable Unit 2 total soil data set consists of 73 samples collected at depths ranging from zero to 30 feet from 32 locations (Table 3-48, Figure 3-1). Sixteen PCOIs, including nine organic compounds and seven inorganic compounds, are identified in Operable Unit 2 total soil based on protection of groundwater (Table 3-48). Maximum detected concentrations of inorganic PCOIs in

Operable Unit 2 total soil are compared to UBLs for soil. Six PCOIs are eliminated from further consideration based on a comparison to UBLs (Table 3-49, Figure 3-17). Two additional PCOIs are eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-50, Figure 3-17). A total of eight organic chemicals are identified as COIs in Operable Unit 2 total soil for the protection of groundwater (Figure 3-17).

Perched Groundwater

The Operable Unit 2 perched groundwater data set consists of 24 samples collected from 15 monitoring wells (Table 3-51, Figure 3-2). Twenty PCOIs are identified in Operable Unit 2 perched groundwater, including 16 organic compounds and four inorganic compounds (Table 3-51). A summary of the results of the COI selection process for Operable Unit 2 perched groundwater is presented in Figure 3-18.

Maximum detected concentrations of inorganic PCOIs in Operable Unit 2 perched groundwater are compared to UBLs for perched groundwater. One PCOI is eliminated from further consideration based on a comparison to UBLs (Table 3-52, Figure 3-18). No PCOIs are eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-53, Figure 3-18).

A total of 19 chemicals are identified as COIs in Operable Unit 2 perched groundwater (Figure 3-18):

<u>Inorganics</u>	<u>Organics</u>	
cadmium	benzene	2-methylnaphthalene
chromium	bis(2-ethylhexyl)phthalate	naphthalene
nickel	dibenzofuran	phenanthrene
	1,2-dichloroethane	tetrachloroethene
	1,1-dichloroethene	total petroleum hydrocarbons
	cis-1,2-dichloroethene	1,1,1-trichloroethane
	fluorene	trichloroethene
	methylene chloride	vinyl chloride

The exposure point concentrations for COIs in Operable Unit 2 perched groundwater are identified in Table 3-54.

Upper Sand and Gravel Groundwater

The Operable Unit 2 upper sand and gravel groundwater data set consists of 48 samples collected from 17 monitoring wells (Table 3-55, Figure 3-2). Seventeen PCOIs are identified in Operable Unit 2 upper sand and gravel groundwater, including 14 organic compounds and three inorganic compounds (Table 3-55). Maximum detected concentrations of inorganic PCOIs in Operable Unit 2 upper sand and gravel groundwater are compared to UBLs for upper sand and gravel groundwater. Two PCOIs are eliminated from further consideration based on a comparison to UBLs (Table 3-56, Figure 3-19). Five additional PCOIs are eliminated from further consideration based on a comparison

to health-based benchmarks (Table 3-57, Figure 3-19). A total of ten organic chemicals are identified as COIs in Operable Unit 2 upper sand and gravel groundwater (Figure 3-19).

Lower Sand and Gravel Groundwater

The Operable Unit 2 lower sand and gravel groundwater data set consists of 33 samples collected from 14 monitoring wells (Table 3-58, Figure 3-2). Eleven PCOIs are identified in Operable Unit 2 lower sand and gravel groundwater, including nine organic compounds and two inorganic compounds (Table 3-58). Maximum detected concentrations of inorganic PCOIs in Operable Unit 2 lower sand and gravel groundwater are compared to UBLs for lower sand and gravel groundwater. No PCOIs are eliminated from further consideration based on a comparison to UBLs (Table 3-59, Figure 3-20) and a comparison to health-based benchmarks (Table 3-60, Figure 3-20). Therefore, all eleven PCOIs are identified as COIs in Operable Unit 2 lower sand and gravel groundwater (Figure 3-20).

3.4.3 Operable Unit 3

Operable Unit 3 includes SWMUs 17 - 19 (Reading Road Construction Debris Area, Sludge Basin Landfill, East Landfarm) located in the eastern portion of the site (Figure 2-2).

3.4.3.1 Total Soil

The Operable Unit 3 total soil data set consists of 28 samples collected at depths ranging from zero to 28 feet from 23 locations (Table 3-61, Figure 3-1). This data set is defined for the evaluation of potential human exposures to Operable Unit 3 soil during potential excavation activities as described in Section 5.0. Six PCOIs are identified in Operable Unit 3 total soil, including one organic compound and five inorganic compounds (Table 3-61). A summary of the results of the COI selection process for Operable Unit 3 total soil is presented in Figure 3-21.

Maximum detected concentrations of inorganic PCOIs in Operable Unit 3 total soil are compared to UBLs for soil. No inorganic PCOIs are eliminated from further consideration based on a comparison to UBLs (Table 3-62, Figure 3-21). As discussed in Section 3.1.2, concentrations of arsenic and beryllium are also compared to Ohio farm soil levels. Concentrations of arsenic and beryllium in Operable Unit 3 total soil are plotted and compared to background levels in Figures 3-22 and 3-23, respectively. These two PCOIs are eliminated from further consideration since concentrations are within the ranges for Ohio farm soil and do not appear to be associated with a release from a SWMU (Table 3-62, Figure 3-21). The remaining four PCOIs are eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-63, Figure 3-21). Therefore, no COIs are identified in Operable Unit 3 total soil (Figure 3-21).

3.4.3.2 Surface Soil

The Operable Unit 3 surface soil data set consists of 14 samples collected from 14 locations (Table 3-64, Figure 3-1). This data set is defined for the evaluation of potential human exposures to Operable Unit 3 surface soil as described in Section 5.0. Six PCOIs are identified in Operable Unit 3 surface soil, including one organic compound and five inorganic compounds (Table 3-64). A

summary of the results of the COI selection process for Operable Unit 3 surface soil is presented in Figure 3-24.

Maximum detected concentrations of inorganic PCOIs in Operable Unit 3 surface soil are compared to UBLs for soil. One inorganic chemical is eliminated from further consideration based on a comparison to UBLs (Table 3-65, Figure 3-24). As discussed in Section 3.1.2, concentrations of arsenic and beryllium are also compared to Ohio farm soil levels. Concentrations of arsenic and beryllium in Operable Unit 3 surface soil are plotted and compared to background levels in Figures 3-25 and 3-26, respectively. These two PCOIs are eliminated from further consideration since concentrations are within the ranges for Ohio farm soil and do not appear to be associated with a release from a SWMU (Table 3-65, Figure 3-24). The remaining three PCOIs are eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-66, Figure 3-24). Therefore, no COIs are identified in Operable Unit 3 surface soil (Figure 3-24). It should be noted that, since a residential scenario (*i.e.*, a farmer) is evaluated for OU3, concentrations of PCOIs in OU3 surface soil are compared to residential health-based benchmarks (see Section 5.1.3).

3.4.3.3 Groundwater

The Operable Unit 3 groundwater data set consists of two samples collected from two monitoring wells (Figure 3-2). No groundwater samples were collected from the lower sand and gravel aquifer. COIs are identified for total soil (protection of groundwater) as well as for upper sand and gravel aquifer; however, exposure point concentrations are not calculated.

Total Soil (Protection of Groundwater)

The Operable Unit 3 total soil data set consists of 28 samples collected at depths ranging from zero to 28 feet from 23 locations (Table 3-67, Figure 3-1). Fourteen PCOIs, including four organic compounds and ten inorganic compounds, are identified in Operable Unit 3 total soil based on protection of groundwater (Table 3-67). Maximum detected concentrations of inorganic PCOIs in Operable Unit 3 total soil are compared to UBLs for soil. No PCOIs are eliminated from further consideration based on a comparison to UBLs (Table 3-68, Figure 3-27). As discussed in Section 3.1.2, concentrations of arsenic are also compared to Ohio farm soil levels. Concentrations of arsenic in Operable Unit 3 total soil are plotted and compared to background levels in Figure 3-22. This PCOI is eliminated from further consideration since concentrations are within the ranges for Ohio farm soil and do not appear to be associated with a release from a SWMU (Table 3-68, Figure 3-27). Six additional PCOIs are eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-69, Figure 3-27). Two chemicals (one inorganic and one organic) are identified as COIs in Operable Unit 3 total soil for the protection of groundwater (Figure 3-27).

Perched Groundwater

The Operable Unit 3 perched groundwater data set consists of one sample (18-MW-1S). No PCOIs are identified in Operable Unit 3 perched groundwater since all chemical concentrations are below detection limits.

Upper Sand and Gravel Groundwater

The Operable Unit 3 upper sand and gravel groundwater data set consists of one sample (GM-7S). Two organic PCOIs are identified in Operable Unit 3 upper sand and gravel groundwater (Table 3-70). No PCOIs are eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-71, Figure 3-28). Therefore, both organic PCOIs are identified as COIs in Operable Unit 3 upper sand and gravel groundwater (Figure 3-28).

3.4.4 Operable Unit 4

Operable Unit 4 includes SWMUs 27-31 (Lime Precipitation Basins) located in the eastern portion of the site (Figure 2-2).

3.4.4.1 Total Soil

The Operable Unit 4 total soil data set consists of 13 samples collected at depths ranging from zero to 14 feet from eight locations (Table 3-72, Figure 3-1). This data set is defined for the evaluation of potential human exposures to Operable Unit 4 soil during potential excavation activities as described in Section 5.0. Seven PCOIs are identified in Operable Unit 4 total soil, including two organic compounds and five inorganic compounds (Table 3-72). A summary of the results of the COI selection process for Operable Unit 4 total soil is presented in Figure 3-29.

Maximum detected concentrations of inorganic PCOIs in Operable Unit 4 total soil are compared to UBLs for soil. No inorganic PCOIs are eliminated from further consideration based on a comparison to UBLs (Table 3-73, Figure 3-29). As discussed in Section 3.1.2, concentrations of arsenic and beryllium are also compared to Ohio farm soil levels. Concentrations of arsenic and beryllium in Operable Unit 4 total soil are plotted and compared to background levels in Figures 3-30 and 3-31, respectively. Beryllium is eliminated from further consideration since concentrations are within the ranges for Ohio farm soil and do not appear to be associated with a release from a SWMU (Table 3-73, Figure 3-29). Four additional PCOIs are eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-74, Figure 3-29).

A total of two inorganic chemicals (arsenic and lead) are identified as COIs in Operable Unit 4 total soil (Figure 3-29). The exposure point concentrations for COIs in Operable Unit 4 total soil are identified in Table 3-75.

3.4.4.2 Surface Soil

The Operable Unit 4 surface soil data set consists of four samples collected from four locations (Table 3-71, Figure 3-1). This data set is defined for the evaluation of potential human exposures to Operable Unit 4 surface soil as described in Section 5.0. Five inorganic PCOIs are identified in Operable Unit 4 surface soil (Table 3-76). A summary of the results of the COI selection process for Operable Unit 4 surface soil is presented in Figure 3-32.

Maximum detected concentrations of inorganic PCOIs in Operable Unit 4 surface soil are compared to UBLs for soil. Two inorganic chemicals are eliminated from further consideration based on a comparison to UBLs (Table 3-77, Figure 3-32). As discussed in Section 3.1.2, concentrations of arsenic are also compared to Ohio farm soil levels. Concentrations of arsenic in Operable Unit 4 surface soil are plotted and compared to background levels in Figure 3-33. This PCOI is not eliminated from further consideration based on a comparison to Ohio farm soil levels (Table 3-77, Figure 3-32). One additional PCOI is eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-78, Figure 3-32).

A total of two inorganic chemicals (arsenic and lead) are identified as COIs in Operable Unit 4 surface soil] (Figure 3-32). The exposure point concentrations for COIs in Operable Unit 4 surface soil are identified in Table 3-79.

3.4.4.3 Groundwater

The Operable Unit 4 groundwater data set consists of four samples collected from four monitoring wells (Figure 3-2). No groundwater samples were collected from the upper sand and gravel aquifer. COIs are identified for total soil (protection of groundwater) as well as for the lower sand and gravel aquifer; however, exposure point concentrations are not calculated.

Total Soil (Protection of Groundwater)

The Operable Unit 4 total soil data set consists of 13 samples collected at depths ranging from zero to 14 feet from eight locations (Table 3-80, Figure 3-1). Seventeen PCOIs, including six organic compounds and 11 inorganic compounds, are identified in Operable Unit 4 total soil based on protection of groundwater (Table 3-80). Maximum detected concentrations of inorganic PCOIs in Operable Unit 4 total soil are compared to UBLs for soil. Two PCOIs are eliminated from further consideration based on a comparison to UBLs (Table 3-81, Figure 3-34). As discussed in Section 3.1.2, concentrations of arsenic are also compared to Ohio farm soil levels. Concentrations of arsenic in Operable Unit 4 total soil are plotted and compared to background levels in Figure 3-30. This PCOI is not eliminated from further consideration based on a comparison to Ohio farm soil levels (Table 3-81, Figure 3-34). Five additional PCOIs are eliminated from further consideration based on a comparison to health-based benchmarks (Table 3-82, Figure 3-34). A total of nine chemicals are identified as COIs in Operable Unit 4 total soil for the protection of groundwater, including seven inorganic chemicals and two organic chemicals (Figure 3-34).

Perched Groundwater

The Operable Unit 4 perched groundwater data set consists of one sample (27_28-MW-1S). No PCOIs are identified in Operable Unit 4 perched groundwater since all chemical concentrations are below detection limits.

Lower Sand and Gravel Groundwater

The Operable Unit 4 lower sand and gravel groundwater data set consists of three samples collected from three monitoring wells (Table 3-83, Figure 3-2). One organic PCOI is identified in Operable

Unit 4 lower sand and gravel groundwater (Table 3-83) and is considered a COI since the detected concentration is above the health-based benchmark (Table 3-84, Figure 3-35).

TABLE 3-1
IDENTIFICATION OF PRELIMINARY CHEMICALS OF INTEREST IN SITEWIDE SOIL
GEAE EVENDALE
(Page 1 of 2)

Chemical	Detection Frequency	Concentration (mg/kg)					PCOI?	
		Minimum	Maximum	UBL	PRG	SSL	Direct Contact	Groundwater Protection
Acenaphthene	2/49	4.0E-01	6.4E-01	NA	1.1E+02	5.7E+02	NO	NO
Acetone	103/387	6.0E-03	1.5E+01	NA	8.8E+03	1.6E+01	NO	NO
Aluminum	176/176	1.6E+03	7.7E+04	2.7E+04	1.0E+05	NA	NO	YES
Anthracene	2/48	9.0E-01	2.5E+00	NA	5.7E+00	1.2E+04	NO	NO
Antimony	88/176	1.0E-01	5.0E+01	9.5E+00	6.8E+02	5.0E+00	NO	YES
Aroclor-1248	15/80	6.3E-01	3.9E+02	NA	3.4E-01	1.0E+00	YES	YES
Aroclor-1254	4/80	1.8E+00	4.0E+00	NA	3.4E-01	1.0E+00	YES	YES
Aroclor-1260	1/80	9.0E+00	9.0E+00	NA	3.4E-01	1.0E+00	YES	YES
Arsenic	174/176	8.5E-01	2.3E+02	1.1E+01	2.4E+00	2.9E+01	YES	YES
Barium	148/176	5.3E+00	6.3E+02	3.9E+02	1.0E+05	1.6E+03	NO	NO
Benzene	13/391	6.0E-03	1.8E+00	NA	1.4E+00	3.0E-02	YES	YES
Benzo(a)Anthracene	4/49	3.9E-01	2.9E+00	NA	2.6E+00	2.0E+00	YES	YES
Benzo(a)Pyrene	4/49	3.6E-01	2.5E+00	NA	2.6E-01	8.0E+00	YES	NO
Benzo(b)Fluoranthene	5/49	5.2E-01	4.6E+00	NA	2.6E+00	5.0E+00	YES	NO
Benzo(ghi)Perylene	4/49	2.3E-01	1.6E+00	NA	1.0E+02	4.2E+03	NO	NO
Benzo(k)Fluoranthene	4/49	2.1E-01	1.4E+00	NA	2.6E+01	4.9E+01	NO	NO
Beryllium	129/176	1.4E-01	3.0E+00	2.1E+00	1.1E+00	6.3E+01	YES	NO
Bis(2-Ethylhexyl)Phthalate	4/49	4.4E-01	1.7E+00	NA	1.4E+02	3.6E+03	NO	NO
Bismuth	65/176	1.7E-01	3.2E+02	NA	8.5E+02	8.0E+00	NO	YES
Calcium	176/176	2.0E+03	4.0E+05	1.4E+05	NA	NA	NO ^a	NO ^a
Carbon Disulfide	1/362	7.0E-03	7.0E-03	NA	2.4E+01	3.2E+01	NO	NO
Chlorobenzene	2/362	7.0E-03	9.0E-03	NA	2.2E+02	1.0E+00	NO	NO
Chromium	176/176	3.0E+00	4.8E+03	3.2E+01	1.6E+07	NA	NO	NO ^b
Chrysene	4/49	4.1E-01	2.4E+00	NA	7.2E+00	1.6E+02	NO	NO
Cobalt	128/176	8.2E-01	1.3E+02	1.7E+01	9.7E+04	NA	NO	YES
Copper	151/176	1.2E+00	5.1E+03	3.3E+01	6.3E+04	NA	NO	YES
Cyanide	9/162	7.0E-01	1.5E+03	NA	1.4E+04	4.0E+01	NO	YES
Dibenz(a,h)Anthracene	1/49	3.7E-01	3.7E-01	NA	1.0E+02	2.0E+00	NO	NO
Dibenzofuran	2/49	3.4E-01	2.2E+00	NA	1.4E+02	1.2E+04	NO	NO
Dichlorobenzene, 1,4-	1/49	9.8E-01	9.8E-01	NA	8.5E+00	2.0E+00	NO	NO
Dichloroethane, 1,1-	4/362	1.0E-02	1.5E+00	NA	1.7E+03	2.3E+01	NO	NO
Dichloroethene, 1,1-	2/362	5.0E-03	3.8E-02	NA	8.0E-02	6.0E-02	NO	NO
Dichloroethene, 1,2-	15/177	6.0E-03	1.2E+01	NA	1.2E+02	4.0E-01	NO	YES
Dichloroethene, Cis-1,2-	5/72	6.0E-03	9.5E-01	NA	1.0E+02	4.0E-01	NO	YES
Dichloroethene, Trans-1,2-	3/189	5.7E-02	3.1E-01	NA	2.7E+02	7.0E-01	NO	NO
Ethylbenzene	18/391	1.1E-02	3.3E+01	NA	2.3E+02	1.3E+01	NO	YES
Fluoranthene	7/49	4.1E-01	5.9E+00	NA	2.7E+04	4.3E+03	NO	NO
Fluorene	3/49	4.3E-01	3.5E+00	NA	9.0E+01	5.6E+02	NO	NO
Hexanone, 2-	3/387	7.3E-02	1.2E+00	NA	NA	NA	NO	NO
Indeno(1,2,3-cd)Pyrene	4/49	2.7E-01	1.6E+00	NA	2.6E+00	1.4E+01	NO	NO
Iron	176/176	5.2E+02	4.7E+04	7.0E+04	NA	NA	NO	NO
	184/200	2.0E+00	3.5E+03	3.9E+01	1.0E+03	4.0E+02	YES	YES
Iodine	175/176	1.3E+02	5.0E+04	4.8E+04	NA	NA	NO ^a	NO ^a
Manganese	176/176	1.5E+01	4.9E+04	2.0E+03	4.3E+04	NA	YES	NO ^a

TABLE 3-1
IDENTIFICATION OF PRELIMINARY CHEMICALS OF INTEREST IN SITEWIDE SOIL
GEAE EVENDALE
(Page 2 of 2)

Chemical	Detection Frequency	Concentration (mg/kg)					PCOI?	
		Minimum	Maximum	UBL	PRG	SSL	Direct Contact	Groundwater Protection
<i>Mercury</i>	20/176	1.0E-01	6.3E+00	NA	5.1E+02	NA	NO	<i>YES</i>
<i>Methyl Ethyl Ketone</i>	24/361	1.1E-02	1.8E+00	NA	2.7E+04	NA	NO	<i>YES</i>
<i>Methylene Chloride</i>	21/387	5.0E-03	4.9E-01	NA	1.8E+01	2.0E-02	NO	<i>YES</i>
Methylnaphthalene, 2-	5/49	4.0E-01	1.1E+01	NA	2.4E+02	8.4E+01	NO	NO
Naphthalene	4/49	1.5E+00	5.5E+00	NA	2.4E+02	8.4E+01	NO	NO
Nickel	157/176	2.4E+00	3.8E+04	4.4E+01	3.4E+04	1.3E+02	YES	<i>YES</i>
Pentanone, 4-Methyl-2-	3/387	1.8E-02	2.3E-01	NA	2.8E+03	NA	NO	NO
Phenanthrene	6/49	5.7E-01	8.9E+00	NA	1.0E+02	4.2E+03	NO	NO
Potassium	120/176	2.4E+02	4.2E+03	5.6E+03	NA	NA	NO	NO
Pyrene	7/49	3.6E-01	7.0E+00	NA	1.0E+02	4.2E+03	NO	NO
Selenium	34/157	1.2E-01	4.8E+00	NA	8.5E+03	5.0E+00	NO	NO
Silver	16/176	1.4E-01	3.4E+01	NA	8.5E+03	3.4E+01	NO	NO
Sodium	108/176	1.2E+02	4.2E+03	5.4E+02	NA	NA	NO ^a	NO ^a
<i>Tetrachloroethene</i>	24/362	6.0E-03	3.6E+00	NA	1.7E+01	6.0E-02	NO	<i>YES</i>
<i>Thallium</i>	40/176	9.3E-02	1.1E+00	NA	1.4E+02	7.0E-01	NO	<i>YES</i>
<i>Toluene</i>	32/391	5.0E-03	5.1E+01	NA	8.8E+02	1.2E+01	NO	<i>YES</i>
Total Petroleum Hydrocarbons^c	152/310	1.1E+01	4.6E+04	NA	3.6E+02	7.7E+01	YES	<i>YES</i>
<i>T oroethane, 1,1,1-</i>	95/362	6.0E-03	3.0E+02	NA	3.0E+03	2.0E+00	NO	<i>YES</i>
<i>roethene</i>	82/362	6.0E-03	2.5E+01	NA	7.0E+00	6.0E-02	YES	<i>YES</i>
Vanadium	176/176	4.0E+00	1.6E+03	6.1E+01	1.2E+04	6.0E+03	NO	NO
Vinyl Chloride	5/363	2.0E-02	5.9E-01	NA	3.5E-02	1.0E-02	YES	<i>YES</i>
Xylene, O-	3/72	1.3E-02	5.9E+01	NA	3.2E+02	1.9E+02	NO	NO
Xylenes	23/391	9.0E-03	1.4E+02	NA	3.2E+02	1.9E+02	NO	NO
Zinc	176/176	7.5E+00	1.1E+04	1.8E+02	1.0E+05	1.2E+04	NO	NO

^a Chemical was not considered a hazard since it is an essential nutrient.

^b Chromium III is not a concern for this pathway (USEPA, 1996b).

^c Average PRG or SSL for total petroleum hydrocarbons (see Section 4.0).

NA Not available.

PCOI Preliminary chemical of interest.

PRG Preliminary remediation goal for industrial soil (USEPA, 1996a).

SSL Soil screening level for the protection of groundwater (USEPA, 1996b).

UBL Upper background level for soil (see Table 3-6).

Bolded chemicals exceed health-based benchmarks for direct contact.

Italicized chemicals exceed health-based benchmarks for protection of groundwater.

TABLE 3-2
IDENTIFICATION OF PRELIMINARY CHEMICALS OF INTEREST IN
SITEWIDE SEDIMENT
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Concentration (mg/kg)				PCOI?
	Frequency	Minimum	Maximum	UBL	PRG	
Acetone	6/29	1.2E-02	3.4E+00	NA	8.8E+03	NO
Aluminum	27/27	4.5E+02	1.5E+04	2.7E+04	1.0E+05	NO
Antimony	2/27	8.0E+00	2.6E+01	9.5E+00	6.8E+02	NO
Arsenic	25/27	3.8E+00	2.7E+01	1.1E+01	2.4E+00	YES
Barium	27/27	1.8E+01	1.7E+03	3.9E+02	1.0E+05	NO
Benzene	3/29	1.3E+01	8.2E+02	NA	1.4E+00	YES
Beryllium	18/27	3.7E-01	1.6E+00	2.1E+00	1.1E+00	NO
Cadmium	26/27	1.6E+00	5.8E+02	NA	8.5E+02	NO
Calcium	27/27	1.4E+04	2.0E+05	1.4E+05	NA	NO ^a
Chromium	26/27	1.4E+01	7.8E+02	3.2E+01	1.6E+07	NO
Cobalt	23/27	3.2E+00	1.4E+02	1.7E+01	9.7E+04	NO
Copper	27/27	2.0E+01	1.6E+03	3.3E+01	6.3E+04	NO
Cyanide	1/3	1.2E+00	1.2E+00	NA	1.4E+04	NO
Dichloroethane, 1,1-	2/29	1.1E-02	6.2E+01	NA	1.7E+03	NO
Ethylbenzene	2/29	8.9E+01	8.4E+02	NA	2.3E+02	YES
Iron	27/27	1.7E+03	2.3E+05	7.0E+04	NA	NO ^a
Lead	27/27	1.5E+01	1.8E+03	3.9E+01	1.0E+03	YES
Magnesium	27/27	4.8E+03	4.7E+04	4.8E+04	NA	NO
Manganese	27/27	6.9E+01	8.2E+04	2.0E+03	4.3E+04	YES
Mercury	20/27	6.0E-02	6.9E+00	NA	5.1E+02	NO
Methyl Ethyl Ketone	2/29	2.0E-02	1.1E+00	NA	2.7E+04	NO
Methylene Chloride	1/29	1.6E+00	1.6E+00	NA	1.8E+01	NO
Nickel	27/27	1.5E+01	1.3E+03	4.4E+01	3.4E+04	NO
Potassium	17/27	2.7E+02	2.0E+03	5.6E+03	NA	NO
Selenium	10/27	6.1E-01	1.2E+01	NA	8.5E+03	NO
Silver	12/27	2.0E+00	7.0E+01	NA	8.5E+03	NO
Sodium	25/27	1.6E+02	3.7E+03	5.4E+02	NA	NO ^a
Thallium	2/27	5.6E-01	9.4E+00	NA	1.4E+02	NO
Toluene	5/29	1.3E+00	3.8E+03	NA	8.8E+02	YES
Trichloroethane, 1,1,1-	1/29	7.4E+02	7.4E+02	NA	3.0E+03	NO
Trichloroethene	1/29	6.0E-03	6.0E-03	NA	7.0E+00	NO
Vanadium	20/27	4.7E+00	9.7E+01	6.1E+01	1.2E+04	NO
Xylene, O-	2/25	3.4E+01	1.9E+02	NA	3.2E+02	NO
Xylenes	4/29	7.2E+01	6.2E+03	NA	3.2E+02	YES
Zinc	27/27	9.0E+01	4.0E+03	1.8E+02	1.0E+05	NO

^a Chemical was not considered a hazard since it is an essential nutrient.

NA Not available.

PCOI Preliminary chemical of interest.

PRG Preliminary remediation goal for industrial soil (USEPA, 1996a).

UBL Upper background level for soil (see Table 3-6).

Bolded chemicals exceed health-based benchmarks.

TABLE 3-3
IDENTIFICATION OF PRELIMINARY CHEMICAL OF INTEREST
IN SITEWIDE PERCHED GROUNDWATER
GEAE EVENDALE
(Page 1 of 2)

Chemical	Detection	Concentration (mg/L)				PCOI?
	Frequency	Minimum	Maximum	UBL	Benchmark ^a	
Acenaphthene	1/25	2.6E-01	2.6E-01	NA	3.7E-01	NO
Acetone	11/70	3.7E-03	2.4E-02	NA	6.1E-01	NO
Aluminum	33/33	1.9E-03	3.4E+01	7.2E+01	3.7E+01	NO
Aroclor-1242	1/22	7.2E-04	7.2E-04	NA	5.0E-04	YES
Aroclor-1248	2/22	2.0E-04	2.6E-02	NA	5.0E-04	YES
Arsenic	20/33	8.5E-04	7.6E-02	5.1E-02	5.0E-02	YES
Barium	27/33	1.3E-04	1.0E+00	5.3E-01	2.0E+00	NO
Benzene	4/74	6.5E-03	2.0E-01	NA	5.0E-03	YES
Beryllium	1/33	2.5E-03	2.5E-03	6.8E-03	4.0E-03	NO
Bis(2-Ethylhexyl)Phthalate	8/25	1.0E-03	5.3E-01	NA	4.8E-03	YES
Cadmium	11/33	5.5E-04	1.3E-02	6.9E-03	5.0E-03	YES
Calcium	32/33	1.4E-02	5.4E+02	1.5E+03	NA	NO
Carbon Disulfide	1/71	2.5E-03	2.5E-03	NA	2.1E-02	NO
Chloroethane	3/71	2.1E-03	3.3E-01	NA	7.1E-01	NO
Chloroform	1/74	1.1E-03	1.1E-03	NA	1.0E-01	NO
Chromium	27/33	2.1E-05	1.3E+00	2.1E-01	1.0E-01	YES
Cobalt	14/33	1.2E-03	8.3E-02	1.1E-01	2.2E+00	NO
Copper	17/33	7.5E-03	1.8E-01	2.1E-01	1.3E+00	NO
Dibenzofuran	1/25	3.0E-01	3.0E-01	NA	2.4E-02	YES
Dichloroethane, 1,1-	24/75	2.8E-03	2.7E-01	NA	8.1E-01	NO
Dichloroethane, 1,2-	6/74	2.5E-03	1.2E-02	NA	5.0E-03	YES
Dichloroethene, 1,1-	15/75	1.2E-03	1.5E-01	NA	7.0E-03	YES
Dichloroethene, 1,2-	9/28	4.3E-03	1.1E-01	NA	7.0E-02	YES
Dichloroethene, Cis-1,2-	13/35	3.0E-03	2.4E-01	NA	7.0E-02	YES
Dichloroethene, Trans-1,2-	11/46	1.2E-03	1.1E-02	NA	1.0E-01	NO
Ethylbenzene	2/74	5.3E-03	8.0E-03	NA	7.0E-01	NO
Fluorene	1/25	5.5E-01	5.5E-01	NA	2.4E-01	YES
Hexanone, 2-	2/70	1.5E-02	1.8E-02	NA	NA	NO
Iron	33/33	6.4E-03	1.2E+02	2.0E+02	NA	NO
Lead	27/33	1.4E-05	4.8E-02	9.7E-02	1.5E-02	NO
Magnesium	32/33	3.8E-02	1.5E+02	2.4E+02	NA	NO
Manganese	33/33	1.0E-04	4.1E+00	5.3E+00	1.7E+00	NO
Methyl Ethyl Ketone	1/68	2.4E-02	2.4E-02	NA	1.9E+00	NO
Methylene Chloride	6/75	1.4E-03	2.7E-02	NA	5.0E-03	YES
Methylnaphthalene, 2-	4/25	5.0E-03	1.1E+01	NA	2.4E-01	YES
N-Nitrosodiphenylamine	2/25	6.0E-03	1.6E-02	NA	1.4E-02	YES
Naphthalene	2/25	1.1E-02	3.0E+00	NA	2.4E-01	YES
Nickel	18/33	1.0E-02	8.3E-01	1.6E-01	1.0E-01	YES
Phenanthrene	1/25	1.3E+00	1.3E+00	NA	1.8E-01	YES
Potassium	22/33	2.4E-03	1.7E+01	1.7E+01	NA	NO
Selenium	14/33	1.9E-03	2.0E-02	2.7E-02	5.0E-02	NO
Sodium	31/33	2.7E-02	1.9E+02	1.8E+02	NA	NO ^b
Tetrachloroethene	7/74	2.0E-03	5.2E-02	NA	5.0E-03	YES

TABLE 3-3
IDENTIFICATION OF PRELIMINARY CHEMICAL OF INTEREST
IN SITEWIDE PERCHED GROUNDWATER
GEAE EVENDALE
(Page 2 of 2)

Chemical	Detection	Concentration (mg/L)				PCOI?
	Frequency	Minimum	Maximum	UBL	Benchmark ^a	
Thallium	3/33	1.0E-03	1.5E-03	1.3E-02	2.0E-03	NO
Total Petroleum Hydrocarbon	12/30	1.1E+00	1.7E+05	NA	8.0E-01	YES
Trichloroethane, 1,1,1-	29/75	1.4E-03	1.1E+01	NA	2.0E-01	YES
Trichloroethane, 1,1,2-	2/74	6.0E-03	1.1E-02	NA	5.0E-03	YES
Trichloroethene	34/75	3.8E-03	3.6E+00	NA	5.0E-03	YES
Vanadium	16/33	2.4E-03	1.0E-01	1.2E+00	2.6E-01	NO
Vinyl Acetate	3/68	1.3E-02	2.5E+00	NA	4.1E-01	YES
Vinyl Chloride	5/73	5.0E-03	3.3E-02	NA	2.0E-03	YES
Xylene, O-	1/24	1.4E+00	1.4E+00	NA	1.0E+01	NO
Xylenes	4/69	1.2E-02	3.2E+00	NA	1.0E+01	NO
Zinc	19/33	2.9E-05	3.6E-01	6.1E-01	5.0E+00	NO

^a See Table 3-11 for source.

^b Chemical was not considered a hazard since it is an essential nutrient.

NA Not available.

PCOI Preliminary chemical of interest.

UBL Upper background level for perched groundwater (see Table 3-7).

Bolded chemicals exceed health-based benchmarks.

TABLE 3-4
IDENTIFICATION OF PRELIMINARY CHEMICALS OF INTEREST
IN SITEWIDE UPPER SAND AND GRAVEL GROUNDWATER
GEAE EVENDALE
(Page 1 of 2)

Chemical	Detection	Concentration (mg/L)				PCOI?
	Frequency	Minimum	Maximum	UBL	Benchmark ^a	
Acetone	6/44	1.0E-03	1.2E-01	NA	6.1E-01	NO
Aluminum	34/39	5.0E-03	1.5E+01	1.1E+02	3.7E+01	NO
Arsenic	20/39	1.0E-05	2.0E-02	7.5E-02	5.0E-02	NO
Barium	36/39	1.2E-04	6.2E-01	1.8E+00	2.0E+00	NO
Benzene	5/57	1.9E-04	1.2E-02	NA	5.0E-03	YES
Beryllium	3/39	5.0E-06	1.0E-05	7.5E-03	4.0E-03	NO
Bis(2-Ethylhexyl)Phthalate	3/21	2.6E-03	1.2E-02	NA	4.8E-03	YES
Bromodichloromethane	1/57	3.9E-03	3.9E-03	NA	1.0E-01	NO
Bromoform	1/57	1.1E-03	1.1E-03	NA	1.0E-01	NO
Cadmium	9/39	2.0E-06	1.3E-02	NA	5.0E-03	YES
Calcium	39/39	1.4E-01	4.4E+02	7.5E+02	NA	NO
Carbon Disulfide	2/47	2.2E-03	2.2E-02	NA	2.1E-02	YES
Chloroethane	11/54	4.0E-03	3.2E-01	NA	7.1E-01	NO
Chloroform	6/57	2.9E-03	6.8E-03	NA	1.0E-01	NO
Chloromethane	1/52	2.0E-04	2.0E-04	NA	1.5E-03	NO
Chromium	22/39	2.3E-05	1.5E+01	2.2E-01	1.0E-01	YES
Cobalt	9/39	6.0E-05	1.4E-01	NA	2.2E+00	NO
Copper	19/39	3.0E-05	5.8E-01	1.9E-01	1.3E+00	NO
Di-n-Octyl Phthalate	1/21	3.1E-03	3.1E-03	NA	7.3E-01	NO
Dibromochloromethane	1/57	4.5E-03	4.5E-03	NA	1.0E-01	NO
Dichloroethane, 1,1-	50/57	2.4E-03	6.2E+00	NA	8.1E-01	YES
Dichloroethane, 1,2-	6/57	1.1E-03	1.0E-02	NA	5.0E-03	YES
Dichloroethene, 1,1-	30/57	2.3E-03	1.0E-01	NA	7.0E-03	YES
Dichloroethene, 1,2-	13/18	2.0E-03	1.7E-01	NA	7.0E-02	YES
Dichloroethene, Cis-1,2-	31/34	8.4E-04	7.5E-01	NA	7.0E-02	YES
Dichloroethene, Trans-1,2-	31/39	7.2E-04	7.2E-01	NA	1.0E-01	YES
Dimethyl Phthalate	1/21	2.0E-03	2.0E-03	NA	3.7E+02	NO
Fluorene	1/21	3.0E-03	3.0E-03	NA	2.4E-01	NO
Hexanone, 2-	2/44	3.3E-03	3.5E-03	NA	NA	NO
Iron	39/39	2.4E-02	1.7E+02	2.3E+02	NA	NO
Lead	27/39	3.0E-05	6.4E-02	1.3E-01	1.5E-02	NO
Magnesium	39/39	3.6E-02	1.4E+02	1.6E+02	NA	NO
Manganese	39/39	5.8E-04	2.4E+00	5.5E+00	1.7E+00	NO
Mercury	2/39	2.0E-07	3.0E-07	NA	2.0E-03	NO
Methyl Ethyl Ketone	5/42	6.3E-03	3.9E-02	NA	1.9E+00	NO
Methylene Chloride	7/57	1.2E-03	2.5E-02	NA	5.0E-03	YES
N-Nitrosodiphenylamine	7/21	2.0E-03	1.5E-02	NA	1.4E-02	YES
Nickel	19/39	4.0E-05	1.6E+00	1.3E-01	1.0E-01	YES
Pentanone, 4-Methyl-2-	1/42	2.7E-03	2.7E-03	NA	1.6E-01	NO
Phenanthrene	1/21	2.0E-03	2.0E-03	NA	1.8E-01	NO
Potassium	30/39	3.4E-03	6.0E+00	9.1E+00	NA	NO
Selenium	3/39	7.0E-06	3.1E-03	NA	5.0E-02	NO
Silver	1/39	9.6E-04	9.6E-04	NA	1.8E-01	NO

TABLE 3-4
IDENTIFICATION OF PRELIMINARY CHEMICALS OF INTEREST
IN SITEWIDE UPPER SAND AND GRAVEL GROUNDWATER
GEAE EVENDALE
(Page 2 of 2)

Chemical	Detection Frequency	Concentration (mg/L)				PCOI?
		Minimum	Maximum	UBL	Benchmark ^a	
Sodium	39/39	3.3E-02	2.5E+02	3.9E+01	NA	NO ^b
Tetrachloroethene	3/57	1.5E-03	9.0E-03	NA	5.0E-03	YES
Thallium	1/39	2.0E-03	2.0E-03	NA	2.0E-03	NO
Toluene	2/57	1.2E-03	1.0E-02	NA	1.0E+00	NO
Trichloroethane, 1,1,1-	13/57	1.1E-03	4.3E-01	NA	2.0E-01	YES
Trichloroethene	18/57	1.0E-03	1.7E+00	NA	5.0E-03	YES
Vanadium	16/39	5.0E-05	1.4E-01	1.7E-01	2.6E-01	NO
Vinyl Chloride	16/55	3.1E-03	1.1E-01	NA	2.0E-03	YES
Zinc	34/39	3.7E-05	2.4E-01	5.1E-01	5.0E+00	NO

^a See Table 3-11 for source.

^b Chemical was not considered a hazard since it is an essential nutrient.

NA Not available.

PCOI Preliminary chemical of interest.

UBL Upper background level for upper sand and gravel groundwater (see Table 3-8).

Bolded chemicals exceed health-based benchmarks.

TABLE 3-5
IDENTIFICATION OF PRELIMINARY CHEMICALS OF INTEREST
IN SITEWIDE LOWER SAND AND GRAVEL GROUNDWATER
GEAE EVENDALE
(Page 1 of 2)

Chemical	Detection	Concentration (mg/L)			Benchmark ^a	PCOI?
	Frequency	Minimum	Maximum	UBL		
Acetone	5/36	2.3E-03	3.2E-01	NA	6.1E-01	NO
Aluminum	24/28	9.1E-04	2.2E+00	1.2E+00	3.7E+01	NO
Arsenic	17/28	2.6E-05	4.1E-02	1.2E-01	5.0E-02	NO
Barium	24/28	1.7E-04	7.3E-01	5.2E-01	2.0E+00	NO
Benzene	9/43	2.1E-04	1.8E-01	NA	5.0E-03	YES
Bis(2-Ethylhexyl)Phthalate	8/17	2.0E-03	6.6E-02	NA	4.8E-03	YES
Bromodichloromethane	1/43	2.7E-03	2.7E-03	NA	1.0E-01	NO
Bromophenyl Phenyl Ether, 4-	1/17	3.0E-03	3.0E-03	NA	NA	YES
Butylbenzene, n-	1/6	1.5E-03	1.5E-03	NA	7.0E-01	NO
Cadmium	2/28	3.0E-06	1.0E-03	NA	5.0E-03	NO
Calcium	28/28	1.2E-01	2.3E+02	2.1E+02	NA	NO ^b
Carbon Disulfide	1/37	2.7E-03	2.7E-03	NA	2.1E-02	NO
Chlordane, Alpha-	1/20	2.0E-04	2.0E-04	NA	2.0E-03	NO
Chloroethane	3/40	2.0E-03	1.1E-02	NA	7.1E-01	NO
Chloroform	3/43	3.3E-03	1.7E-02	NA	1.0E-01	NO
Chloromethane	1/40	4.1E-02	4.1E-02	NA	1.5E-03	YES
Chromium	18/28	1.3E-05	2.8E-01	7.1E-02	1.0E-01	YES
Cobalt	1/28	1.7E-02	1.7E-02	NA	2.2E+00	NO
Copper	10/28	3.5E-05	3.0E-02	NA	1.3E+00	NO
DDT, 4,4'-	1/20	1.3E-04	1.3E-04	NA	2.0E-04	NO
Di-n-Butyl Phthalate	8/17	3.0E-03	1.2E-01	NA	3.7E+00	NO
Dibromochloromethane	2/43	2.3E-03	4.0E-03	NA	1.0E-01	NO
Dichloroethane, 1,1-	16/43	5.5E-04	1.5E-01	NA	8.1E-01	NO
Dichloroethene, 1,1-	3/43	8.2E-03	2.3E-02	NA	7.0E-03	YES
Dichloroethene, 1,2-	1/11	1.3E-02	1.3E-02	NA	7.0E-02	NO
Dichloroethene, Cis-1,2-	14/26	2.9E-04	2.6E-01	NA	7.0E-02	YES
Dichloroethene, Trans-1,2-	9/32	1.4E-03	4.2E-02	NA	1.0E-01	NO
Dimethyl Phthalate	1/17	4.0E-03	4.0E-03	NA	3.7E+02	NO
Dimethylphenol, 2,4-	1/17	3.1E-03	3.1E-03	NA	7.3E-01	NO
Ethylbenzene	3/43	1.5E-03	2.6E-02	NA	7.0E-01	NO
Heptachlor	1/20	7.6E-05	7.6E-05	NA	4.0E-04	NO
Iron	28/28	2.1E-03	1.5E+01	1.2E+01	NA	NO ^b
Isopropylbenzene	2/6	1.9E-03	9.0E-03	NA	1.9E-02	NO
Lead	19/28	5.6E-06	6.3E-03	NA	1.5E-02	NO
Magnesium	28/28	3.1E-02	4.1E+01	4.1E+01	NA	NO
Manganese	28/28	5.9E-04	1.6E+00	1.0E+00	1.7E+00	NO
Methylene Chloride	6/43	1.6E-03	2.6E-03	NA	5.0E-03	NO
Methylnaphthalene, 2-	1/17	2.8E-02	2.8E-02	NA	2.4E-01	NO
N-Nitrosodiphenylamine	1/17	3.0E-03	3.0E-03	NA	1.4E-02	NO
Naphthalene	1/17	1.5E-02	1.5E-02	NA	2.4E-01	NO
Naphthalene (8260)	2/6	8.4E-04	2.0E-03	NA	2.4E-01	NO
Nickel	10/28	5.0E-05	2.1E-01	NA	1.0E-01	YES
Potassium	18/28	1.2E-03	3.4E+00	1.5E+01	NA	NO

TABLE 3-5
IDENTIFICATION OF PRELIMINARY CHEMICALS OF INTEREST
IN SITEWIDE LOWER SAND AND GRAVEL GROUNDWATER
GEAE EVENDALE
(Page 2 of 2)

Chemical	Detection	Concentration (mg/L)				PCOI?
	Frequency	Minimum	Maximum	UBL	Benchmark ^a	
Propylbenzene, n-	2/6	1.7E-03	4.0E-03	NA	7.0E-01	NO
Selenium	1/28	5.2E-06	5.2E-06	NA	5.0E-02	NO
Sodium	28/28	3.1E-02	6.2E+01	6.6E+01	NA	NO
Tetrachloroethane, 1,1,2,2-	1/44	7.0E-03	7.0E-03	NA	5.5E-05	YES
Thallium	1/28	1.0E-03	1.0E-03	NA	2.0E-03	NO
Toluene	4/44	9.2E-04	9.0E-03	NA	1.0E+00	NO
Trichloroethane, 1,1,1-	2/44	1.8E-03	7.5E-03	NA	2.0E-01	NO
Trichloroethene	10/44	1.4E-03	3.0E-02	NA	5.0E-03	YES
Trimethylbenzene, 1,2,4-	2/6	1.5E-02	1.8E-02	NA	1.0E+01	NO
Trimethylbenzene, 1,3,5-	2/6	1.7E-03	3.5E-03	NA	1.0E+01	NO
Vanadium	4/28	5.0E-02	5.0E-02	5.0E-02	2.6E-01	NO
Vinyl Chloride	8/42	7.6E-04	7.0E-03	NA	2.0E-03	YES
Xylene, M-	2/6	5.4E-04	4.0E-03	NA	1.0E+01	NO
Xylene, O-	2/25	1.2E-03	1.8E-03	NA	1.0E+01	NO
Xylene, P-	2/6	5.4E-04	4.0E-03	NA	1.0E+01	NO
Xylenes	1/30	3.6E-02	3.6E-02	NA	1.0E+01	NO
Zinc	24/28	3.6E-05	7.6E-02	1.1E-01	5.0E+00	NO

^a See Table 3-11 for source.

^b Chemical was not considered a hazard since it is an essential nutrient.

NA Not available.

PCOI Preliminary chemical of interest.

UBL Upper background level for lower sand and gravel groundwater (see Table 3-9).

Bolded chemicals exceed health-based benchmarks.

TABLE 3-6
DERIVATION OF UPPER BACKGROUND LEVELS (UBLs)
FOR INORGANICS DETECTED IN SOIL ^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection		Mean	SD	Tmean	Tsd	UBL
	Frequency	Distribution ^b					
Aluminum	9/9	Normal	1.3E+04	7.1E+03	9.2E+00	8.6E-01	2.7E+04
Antimony	2/9	Not Determined	4.7E+00	2.2E+00	1.5E+00	3.9E-01	9.5E+00
Arsenic	9/9	Lognormal	5.6E+00	2.1E+00	1.7E+00	3.7E-01	1.1E+01
Barium	6/9	Lognormal	6.0E+01	5.0E+01	3.6E+00	1.2E+00	3.9E+02
Beryllium	4/9	Not Determined	6.3E-01	5.2E-01	-7.2E-01	7.3E-01	2.1E+00
Calcium	9/9	Normal	5.5E+04	4.2E+04	1.0E+01	1.5E+00	1.4E+05
Chromium	9/9	Normal	1.4E+01	8.7E+00	2.5E+00	7.3E-01	3.2E+01
Cobalt	6/9	Normal	7.6E+00	4.5E+00	1.8E+00	7.1E-01	1.7E+01
Copper	9/9	Lognormal	1.5E+01	6.5E+00	2.6E+00	4.4E-01	3.3E+01
Iron	9/9	Lognormal	2.1E+04	1.3E+04	9.8E+00	6.9E-01	7.0E+04
Lead	9/9	Lognormal	1.3E+01	7.8E+00	2.4E+00	6.3E-01	3.9E+01
Magnesium	9/9	Normal	1.8E+04	1.5E+04	9.3E+00	1.1E+00	4.8E+04
Manganese	9/9	Lognormal	5.4E+02	4.6E+02	6.0E+00	7.8E-01	2.0E+03
Nickel	9/9	Lognormal	1.6E+01	8.5E+00	2.7E+00	5.7E-01	4.4E+01
Potassium	6/9	Lognormal	1.2E+03	9.1E+02	6.7E+00	9.6E-01	5.6E+03
Sodium	4/9	Not Determined	3.1E+02	1.1E+02	5.7E+00	2.9E-01	5.4E+02
Vanadium	9/9	Lognormal	2.6E+01	1.2E+01	3.1E+00	4.9E-01	6.1E+01
Zinc	9/9	Lognormal	5.9E+01	4.3E+01	3.9E+00	6.6E-01	1.8E+02

a Source: Table 4-1 of the approved Work Plan (ChemRisk, 1997).

b Distribution determined using test described by D'Agostino et al. (1990).

SD Standard deviation.

Tmean Transformed mean.

Tsd Transformed standard deviation.

TABLE 3-7
DERIVATION OF UPPER BACKGROUND LEVELS (UBLs)
FOR PERCHED GROUNDWATER^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection		Concentration (mg/L)				UBL
	Frequency	Distribution ^b	Mean	SD	Tmean	Tsd	
Aluminum	8/8	Lognormal	1.2E+01	2.2E+01	1.5E+00	1.4E+00	7.2E+01
Arsenic	5/8	Normal	1.7E-02	1.7E-02	-4.8E+00	1.6E+00	5.1E-02
Barium	7/8	Lognormal	1.8E-01	1.3E-01	-1.9E+00	6.3E-01	5.3E-01
Beryllium	4/8	Lognormal	1.9E-03	1.4E-03	-6.5E+00	7.5E-01	6.8E-03
Cadmium	5/8	Lognormal	2.7E-03	1.3E-03	-6.0E+00	5.4E-01	6.9E-03
Calcium	8/8	Undefined	2.3E+02	2.0E+02	5.1E+00	1.1E+00	1.5E+03
Chromium	7/8	Lognormal	4.5E-02	3.9E-02	-3.4E+00	9.3E-01	2.1E-01
Cobalt	5/8	Lognormal	4.3E-02	2.3E-02	-3.3E+00	5.4E-01	1.1E-01
Copper	6/8	Normal	7.5E-02	6.5E-02	-3.2E+00	1.5E+00	2.1E-01
Iron	8/8	Lognormal	3.6E+01	5.1E+01	3.0E+00	1.2E+00	2.0E+02
Lead	6/8	Normal	3.4E-02	3.2E-02	-4.1E+00	1.6E+00	9.7E-02
Magnesium	6/8	Lognormal	7.6E+01	5.9E+01	4.1E+00	6.8E-01	2.4E+02
Manganese	8/8	Lognormal	1.4E+00	1.2E+00	4.0E-02	8.2E-01	5.3E+00
Nickel	4/8	Normal	5.7E-02	5.2E-02	-3.4E+00	1.3E+00	1.6E-01
Potassium	2/8	Not Determined	5.5E+00	6.0E+00	1.4E+00	7.2E-01	1.7E+01
Selenium	5/8	Undefined	7.4E-03	1.1E-02	-5.5E+00	9.3E-01	2.7E-02
Sodium	5/8	Lognormal	4.3E+01	4.0E+01	3.4E+00	9.0E-01	1.8E+02
Thallium	1/8	Not Determined	NA	NA	-6.6E+00	1.1E+00	1.3E-02
Vanadium	8/8	Lognormal	9.8E-02	1.7E-01	-3.5E+00	1.8E+00	1.2E+00
Zinc	6/8	Lognormal	1.5E-01	1.2E-01	-2.2E+00	8.4E-01	6.1E-01

a Source: Table 4-5 of the approved Work Plan (ChemRisk, 1997).

b Distribution determined using test described by D'Agostino et al. (1990).

SD Standard deviation.

Tmean Transformed mean.

Tsd Transformed standard deviation.

TABLE 3-8
DERIVATION OF UPPER BACKGROUND LEVELS (UBLs)
FOR UPPER SAND AND GRAVEL GROUNDWATER^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection		Concentration (mg/L)				UBL
	Frequency	Distribution ^b	Mean	SD	Tmean	Tsd	
Aluminum	4/4	Not Determined	1.9E+01	1.9E+01	2.6E+00	1.1E+00	1.1E+02
Arsenic	3/4	Not Determined	1.3E-02	1.5E-02	-4.8E+00	1.1E+00	7.5E-02
Barium	3/4	Not Determined	4.0E-01	2.6E-01	-1.1E+00	8.5E-01	1.8E+00
Beryllium	1/4	Not Determined	3.4E-03	1.8E-03	-5.8E+00	4.4E-01	7.5E-03
Calcium	4/4	Not Determined	2.8E+02	1.5E+02	5.5E+00	5.4E-01	7.5E+02
Chromium	4/4	Not Determined	5.3E-02	3.9E-02	-3.2E+00	8.4E-01	2.2E-01
Copper	3/4	Not Determined	4.6E-02	3.0E-02	-3.3E+00	8.1E-01	1.9E-01
Iron	4/4	Not Determined	4.2E+01	3.3E+01	3.4E+00	1.0E+00	2.3E+02
Lead	4/4	Not Determined	3.2E-02	2.7E-02	-3.7E+00	8.1E-01	1.3E-01
Magnesium	4/4	Not Determined	6.2E+01	2.8E+01	4.0E+00	5.1E-01	1.6E+02
Manganese	4/4	Not Determined	1.7E+00	1.0E+00	3.6E-01	6.7E-01	5.5E+00
Nickel	3/4	Not Determined	4.8E-02	2.5E-02	-3.2E+00	5.8E-01	1.3E-01
Potassium	1/4	Not Determined	3.6E+00	2.3E+00	1.2E+00	5.1E-01	9.1E+00
Sodium	4/4	Not Determined	2.6E+01	5.3E+00	3.3E+00	2.0E-01	3.9E+01
Vanadium	4/4	Not Determined	7.0E-02	4.0E-02	-2.8E+00	4.8E-01	1.7E-01
Zinc	4/4	Not Determined	1.4E-01	8.2E-02	-2.2E+00	7.5E-01	5.1E-01

a Source: Table 4-6 of the approved Work Plan (ChemRisk, 1997).

b Distribution determined using test described by D'Agostino et al. (1990).

SD Standard deviation.

Tmean Transformed mean.

Tsd Transformed standard deviation.

TABLE 3-9
DERIVATION OF UPPER BACKGROUND LEVELS (UBLs)
FOR LOWER SAND AND GRAVEL GROUNDWATER^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection		Concentration (mg/L)				
	Frequency	Distribution ^b	Mean	SD	Tmean	Tsd	UBL
Aluminum	2/5	Not Determined	2.8E-01	3.5E-01	-1.7E+00	9.5E-01	1.2E+00
Arsenic	4/5	Not Determined	1.9E-02	1.8E-02	-4.4E+00	1.1E+00	1.2E-01
Barium	2/5	Not Determined	1.8E-01	1.3E-01	-1.9E+00	6.2E-01	5.2E-01
Calcium	5/5	Not Determined	8.6E+01	3.5E+01	4.4E+00	4.9E-01	2.1E+02
Chromium	2/5	Not Determined	1.5E-02	1.5E-02	-4.6E+00	9.8E-01	7.1E-02
Iron	5/5	Not Determined	3.5E+00	2.3E+00	1.1E+00	7.1E-01	1.2E+01
Magnesium	5/5	Not Determined	2.3E+01	6.3E+00	3.1E+00	3.0E-01	4.1E+01
Manganese	5/5	Not Determined	2.3E-01	2.0E-01	-1.8E+00	8.9E-01	1.0E+00
Potassium	1/5	Not Determined	4.6E+00	4.7E+00	1.2E+00	7.4E-01	1.5E+01
Sodium	5/5	Not Determined	3.2E+01	1.3E+01	3.4E+00	4.0E-01	6.6E+01
Vanadium	5/5	Not Determined	5.0E-02	6.6E-10	-3.0E+00	4.2E-08	5.0E-02
Zinc	4/5	Not Determined	3.4E-02	1.8E-02	-3.5E+00	6.6E-01	1.1E-01

a Source: Table 4-7 of the approved Work Plan (ChemRisk, 1997).

b Distribution determined using test described by D'Agostino et al. (1990).

SD Standard deviation.

Tmean Transformed mean.

Tsd Transformed standard deviation.

TABLE 3-10
HEALTH-BASED BENCHMARKS FOR SOIL
GEAE EVENDALE
(Page 1 of 2)

Chemical	Benchmark (mg/kg)	
	Direct Contact ^a	Protection of Groundwater ^b
Acenaphthene	1.1E+02	5.7E+02
Acetone	8.8E+03	1.6E+01
Aluminum	1.0E+05	NA
Anthracene	5.7E+00	1.2E+04
Antimony	6.8E+02	5.0E+00
Aroclor-1248	3.4E-01	1.0E+00
Aroclor-1254	3.4E-01	1.0E+00
Aroclor-1260	3.4E-01	1.0E+00
Arsenic	2.4E+00	2.9E+01
Barium	1.0E+05	1.6E+03
Benzene	1.4E+00	3.0E-02
Benzo(a)Anthracene	2.6E+00 ^c	2.0E+00
Benzo(a)Pyrene	2.6E-01	8.0E+00
Benzo(b)Fluoranthene	2.6E+00	5.0E+00
Benzo(ghi)Perylene	1.0E+02 ^c	4.2E+03 ^c
Benzo(k)Fluoranthene	2.6E+01	4.9E+01
Beryllium	1.1E+00	6.3E+01
Bis(2-Ethylhexyl)Phthalate	1.4E+02	3.6E+03
Cadmium	8.5E+02	8.0E+00
Calcium	NA	NA
Carbon Disulfide	2.4E+01	3.2E+01
Chlorobenzene	2.2E+02	1.0E+00
Chromium	1.6E+07 ^d	NA ^e
Chrysene	7.2E+00	1.6E+02
Cobalt	9.7E+04	NA
Copper	6.3E+04	NA
Cyanide	1.4E+04	4.0E+01
Dibenz(a,h)Anthracene	1.0E+02 ^c	2.0E+00
Dibenzofuran	1.4E+02	1.2E+04 ^f
Dichlorobenzene, 1,4-	8.5E+00	2.0E+00
Dichloroethane, 1,1-	1.7E+03	2.3E+01
Dichloroethene, 1,1-	8.0E-02	6.0E-02
Dichloroethene, 1,2-	1.2E+02	4.0E-01 ^g
Dichloroethene, Cis-1,2-	1.0E+02	4.0E-01
Dichloroethene, Trans-1,2-	2.7E+02	7.0E-01
Ethylbenzene	2.3E+02	1.3E+01
Fluoranthene	2.7E+04	4.3E+03
Fluorene	9.0E+01	5.6E+02
Hexanone, 2-	NA	NA
Indeno(1,2,3-cd)Pyrene	2.6E+00	1.4E+01
Iron	NA	NA

TABLE 3-10
HEALTH-BASED BENCHMARKS FOR SOIL
GEAE EVENDALE
(Page 2 of 2)

Chemical	Benchmark (mg/kg)	
	Direct Contact ^a	Protection of Groundwater ^b
Lead	1.0E+03	4.0E+02
Magnesium	NA	NA
Manganese	4.3E+04	NA
Mercury	5.1E+02	NA
Methyl Ethyl Ketone	2.7E+04	NA
Methylene Chloride	1.8E+01	2.0E-02
Methylnaphthalene, 2-	2.4E+02 ^h	8.4E+01 ^h
Naphthalene	2.4E+02	8.4E+01
Nickel	3.4E+04	1.3E+02
Pentanone, 4-Methyl-2-	2.8E+03	NA
Phenanthrene	1.0E+02 ^c	4.2E+03 ^c
Potassium	NA	NA
Pyrene	1.0E+02	4.2E+03
Selenium	8.5E+03	5.0E+00
Silver	8.5E+03	3.4E+01
Sodium	NA	NA
Tetrachloroethene	1.7E+01	6.0E-02
Thallium	1.4E+02 ⁱ	7.0E-01
Toluene	8.8E+02	1.2E+01
Total Petroleum Hydrocarbons	3.6E+02 ^j	7.7E+01 ^j
Trichloroethane, 1,1,1-	3.0E+03	2.0E+00
Trichloroethene	7.0E+00	6.0E-02
Vanadium	1.2E+04	6.0E+03
Vinyl Chloride	3.5E-02	1.0E-02
Xylene, O-	3.2E+02	1.9E+02
Xylenes	3.2E+02	1.9E+02 ^k
Zinc	1.0E+05	1.2E+04

NA Not available.

a Preliminary remediation goal (PRG) for industrial soil (USEPA, 1996a).

b Soil screening level (SSL) for the protection of groundwater (USEPA, 1996b).

c Value for pyrene used as a surrogate.

d Value for trivalent chromium.

e Not a concern for this pathway (USEPA, 1996b).

f Value for anthracene used as a surrogate.

g Value for cis-1,2-dichloroethene.

h Value for naphthalene used as a surrogate.

i Value for thallium chloride.

j Average PRG/SSL for total petroleum hydrocarbons (see Section 4.0).

k Value for o-xylene.

TABLE 3-11
HEALTH-BASED BENCHMARKS FOR GROUNDWATER
GEAE EVENDALE
(Page 1 of 2)

Chemical	Benchmark (mg/L)	Source
Acenaphthene	3.7E-01	PRG
Acetone	6.1E-01	PRG
Aluminum	3.7E+01	PRG
Aroclor-1242	5.0E-04	MCL
Aroclor-1248	5.0E-04	MCL
Arsenic	5.0E-02	MCL
Barium	2.0E+00	MCL
Benzene	5.0E-03	MCL
Beryllium	4.0E-03	MCL
Bis(2-Ethylhexyl)Phthalate	4.8E-03	PRG
Bromodichloromethane	1.0E-01	MCL
Bromoform	1.0E-01	MCL
Bromophenyl Phenyl Ether, 4-	NA	MCL
Butylbenzene, n-	7.0E-01	MCL ^a
Cadmium	5.0E-03	MCL
Calcium	NA	MCL
Carbon Disulfide	2.1E-02	PRG
Chlordane, alpha-	2.0E-03	MCL
Chloroethane	7.1E-01	PRG
Chloroform	1.0E-01	MCL
Chloromethane	1.5E-03	PRG
Chromium	1.0E-01	MCL ^b
Cobalt	2.2E+00	PRG
Copper	1.3E+00	MCL ^c
DDT, 4,4'-	2.0E-04	PRG
Di-n-Butyl Phthalate	3.7E+00	PRG
Di-n-Octyl Phthalate	7.3E-01	PRG
Dibenzofuran	2.4E-02	PRG
Dibromochloromethane	1.0E-01	MCL
Dichloroethane, 1,1-	8.1E-01	PRG
Dichloroethane, 1,2-	5.0E-03	MCL
Dichloroethene, 1,1-	7.0E-03	MCL
Dichloroethene, 1,2-	7.0E-02	MCL ^d
Dichloroethene, Cis-1,2-	7.0E-02	MCL
Dichloroethene, Trans-1,2-	1.0E-01	MCL
Dimethyl Phthalate	3.7E+02	PRG
Dimethylphenol, 2,4-	7.3E-01	PRG
Ethylbenzene	7.0E-01	MCL
Fluorene	2.4E-01	PRG
Heptachlor	4.0E-04	MCL
Hexanone, 2-	NA	MCL
Iron	NA	MCL
Isopropylbenzene	1.9E-02	PRG
Lead	1.5E-02	MCL ^c

TABLE 3-11
HEALTH-BASED BENCHMARKS FOR GROUNDWATER
GEAE EVENDALE
(Page 2 of 2)

Chemical	Benchmark (mg/L)	Source
Magnesium	NA	MCL
Manganese	1.7E+00	PRG
Mercury	2.0E-03	MCL
Methyl Ethyl Ketone	1.9E+00	PRG
Methylene Chloride	5.0E-03	MCL
Methylnaphthalene, 2-	2.4E-01	PRG ^e
N-Nitrosodiphenylamine	1.4E-02	PRG
Naphthalene	2.4E-01	PRG
Nickel	1.0E-01	MCL
Pentanone, 4-Methyl-2-	1.6E-01	PRG
Phenanthrene	1.8E-01	PRG ^f
Potassium	NA	MCL
Propylbenzene, n-	7.0E-01	MCL ^a
Selenium	5.0E-02	MCL
Silver	1.8E-01	PRG
Sodium	NA	MCL
Tetrachloroethane, 1,1,2,2-	5.5E-05	PRG
Tetrachloroethene	5.0E-03	MCL
Thallium	2.0E-03	MCL
Toluene	1.0E+00	MCL
Total Petroleum Hydrocarbons	8.0E-01	PRG ^g
Trichloroethane, 1,1,1-	2.0E-01	MCL
Trichloroethane, 1,1,2-	5.0E-03	MCL
Trichloroethene	5.0E-03	MCL
Trimethylbenzene, 1,2,4-	1.0E+01	MCL ^h
Trimethylbenzene, 1,3,5-	1.0E+01	MCL ^h
Vanadium	2.6E-01	PRG
Vinyl Acetate	4.1E-01	PRG
Vinyl Chloride	2.0E-03	MCL
Xylene, M-	1.0E+01	MCL
Xylene, O-	1.0E+01	MCL
Xylene, P-	1.0E+01	MCL
Xylenes	1.0E+01	MCL
Zinc	5.0E+00	MCL

MCL Maximum contaminant level for drinking water (USEPA, 1996c).

PRG Preliminary remediation goal for tap water (USEPA, 1996a).

a Value for ethyl benzene used as a surrogate.

b Value for total chromium.

c Action level (USEPA, 1996c).

d Value for cis-1,2-dichloroethene.

e Value for naphthalene used as a surrogate.

f Value for pyrene used as a surrogate.

g Average PRG for total petroleum hydrocarbons (see Section 4.0).

h Value for xylenes used as a surrogate.

TABLE 3-12
OPERABLE UNIT 1:
PRELIMINARY CHEMICALS OF INTEREST IN TOTAL SOIL^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Estimated Detects ^b	Detected Range (mg/kg)	
	Frequency	Greater Than 50%		Minimum	Maximum
Aroclor-1248	15/72	No		6.3E-01	3.9E+02
Aroclor-1254	4/72	No		1.8E+00	4.0E+00
Aroclor-1260	1/72	No		9.0E+00	9.0E+00
Arsenic	136/137	Yes	77	8.5E-01	2.4E+01
Benzene	11/292	No	1	6.0E-03	2.4E-01
Benzo(a)Anthracene	4/40	No	1	3.9E-01	2.9E+00
Benzo(a)Pyrene	4/40	No	1	3.6E-01	2.5E+00
Benzo(b)Fluoranthene	5/40	No		5.2E-01	4.6E+00
Beryllium	98/137	Yes	49	1.4E-01	3.0E+00
Lead	145/161	Yes	54	2.0E+00	4.2E+02
Manganese	137/137	Yes	30	1.5E+01	4.9E+04
Nickel	120/137	Yes	39	2.4E+00	3.8E+04
Total Petroleum Hydrocarbons	104/221	No		4.4E+01	4.6E+04
Trichloroethene	73/263	No	3	7.0E-03	2.5E+01
Vinyl Chloride	5/174	No	1	2.0E-02	5.9E-01

^a Based on data from the following sample locations:

100-MW5S	14-SB2	21_22-SB3	503-SB6	507-SB7	703-SB8	93_94-MW2S	PST-SB2
12-SB1	14-SS1	21_22-SB4	503-SB7	507-SB8	703-SB9	95-MW3S	PST-SB3
12-SB3	14-SS2	21_22-SB5	505-SB1	61_67-MW2S	77-SB1	98_99-MW1S	PST-SB4
12-SB3	142-SS1	301-SB1	505-SB10	61_67-MW3S	77-SB2	B-SB1	PST-SB5
12-SS1 (1992)	142-SS2	301-SB2	505-SB11	61_67-SB1	79-SS1	B-SS1	PST-SB6
12-SS1 (1994)	142-SS3	306-SB1	505-SB12	62_63-MW2S	79-SS2	DS3-SB1	PST-SB7
120-SB1	16-MW2S	306-SB2	505-SB13	62_63-MW3S	79-SS3	H-SB1	PST-SB8
120-SB10	16-MW3S	306-SB3	505-SB14	62_63-MW4S	79-SS4	J-SB1	PST-SB9
120-SB2	16-SB1	306-SB4	505-SB15	62_63-SB1	79-SS5	J-SS1	T-MW1S
120-SB3	20-MW1S	306-SB5	505-SB2	64_68-SB1	79-SS6	K-SB1	T-SB1
120-SB4	20-SB1	32-SB1	505-SB3	64_68-SB2	79-SS7	K-SS1	W_4-SB1
120-SB5	20-SB10	32-SB2	505-SB4	65-SB1	79-SS8	L-MW1S	W_4-SB2
120-SB6	20-SB2	46-SB1	505-SB5	65-SB2	79-SS9	L-SB1	W_5-SB1
120-SB7	20-SB3	46-SB2	505-SB6	70-SB1	8-SB10	L-SS1	W_6-MW1S
120-SB8	20-SB4	46-SB3	505-SB7	700_3-SB1	8-SB11	LD-MW2S	W_6-SB1
120-SB9	20-SB5	500_1-SB1	505-SB8	700_4-SB1	8-SB12	LD-MW3S	WDA-SB1
122-SB1	20-SB6	500_3-SB1	505-SB9	703-SB1	8-SB13	LD-SB1	
123-MW1S	20-SB7	500_4-SB1	507-SB1	703-SB2	8-SB15	LD-SB2	
124-MW1S	20-SB8	503-SB1	507-SB2	703-SB3	8_12-SB13A	LD-SB3	
136-S2	20-SB9	503-SB2	507-SB3	703-SB4	8_12-SB14	LD-SB4	
136-S3	21_22-MW1S	503-SB3	507-SB4	703-SB5	800_1-SB1	LD-SB5	
136-SS1	21_22-SB1	503-SB4	507-SB5	703-SB6	86-MW4S	LD-SB6	
14-SB1	21_22-SB2	503-SB5	507-SB6	703-SB7	87_88-SB1	PST-SB1	

^b Value represents the number of detected samples which received a verification of "J".

TABLE 3-13
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF
INORGANIC PCOIs IN TOTAL SOIL TO
BACKGROUND CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/kg)^a	UBL (mg/kg)^b	Above Background?
Arsenic	2.4E+01	1.1E+01	NO ^c
Beryllium	3.0E+00	2.1E+00	NO ^c
Lead	4.2E+02	3.9E+01	YES
Manganese	4.9E+04	2.0E+03	YES
Nickel	3.8E+04	4.4E+01	YES

a Data from Table 3-12.

b Upper background levels (UBLs) for soil (see Table 3-6).

c Eliminated from further consideration since maximum concentration is within
Ohio farm soil background range (Cox and Colvin, 1996):

arsenic 0.5 to 56 mg/kg

beryllium 0.1 to 3.2 mg/kg.

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-14
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF PCOIs IN TOTAL
SOIL TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above PRG?
	Site Maximum ^a	PRG ^b	
Aroclor-1248	3.9E+02	3.4E-01	Yes
Aroclor-1254	4.0E+00	3.4E-01	Yes
Aroclor-1260	9.0E+00	3.4E-01	Yes
Benzene	2.4E-01	1.4E+00	No
Benzo(a)Anthracene	2.9E+00	2.6E+00	Yes
Benzo(a)Pyrene	2.5E+00	2.6E-01	Yes
Benzo(b)Fluoranthene	4.6E+00	2.6E+00	Yes
Lead	4.2E+02	1.0E+03	No
Manganese	4.9E+04	4.3E+04	Yes
Nickel	3.8E+04	3.4E+04	Yes
Total Petroleum Hydrocarbons	4.6E+04	3.6E+02	Yes
Trichloroethene	2.5E+01	7.0E+00	Yes
Vinyl Chloride	5.9E-01	3.5E-02	Yes

^a Data from Table 3-12.

^b Preliminary remediation goals (PRGs) for industrial soil (USEPA, 1996a).

^c Average PRG for total petroleum hydrocarbons (see Section 4.0).

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-15
OPERABLE UNIT 1:
EXPOSURE POINT CONCENTRATIONS FOR COIs IN TOTAL SOIL
GEAE EVENDALE
(Page 1 of 1)

Chemical	Distribution ^a	Statistics (mg/kg) ^b						Exposure Point	
		Arithmetic		95% UCL	Best Estimate	95% UCL	Maximum	Concentrations (mg/kg)	
		Mean	SD	Normal	of Mean	Lognormal	Detected	MLE	RME
Aroclor-1248	Not Determined	1.1E+01	5.0E+01	2.1E+01	2.6E+00	4.9E+00	3.9E+02	2.6E+00	4.9E+00
Aroclor-1254	Not Determined	1.6E+00	5.1E+00	2.6E+00	8.4E-01	1.1E+00	4.0E+00	8.4E-01	1.1E+00
Aroclor-1260	Not Determined	1.6E+00	5.1E+00	2.6E+00	7.7E-01	1.0E+00	9.0E+00	7.7E-01	1.0E+00
Benzo(a)Anthracene	Not Determined	4.5E-01	6.8E-01	6.3E-01	3.8E-01	4.9E-01	2.9E+00	4.5E-01	4.9E-01
Benzo(a)Pyrene	Not Determined	4.0E-01	5.4E-01	5.4E-01	3.5E-01	4.4E-01	2.5E+00	4.0E-01	4.4E-01
Benzo(b)Fluoranthene	Not Determined	5.7E-01	1.0E+00	8.5E-01	4.4E-01	6.1E-01	4.6E+00	5.7E-01	6.1E-01
Manganese	Undefined	4.0E+03	1.1E+04	5.5E+03	2.0E+03	3.2E+03	4.9E+04	2.0E+03	3.2E+03
Nickel	Undefined	4.1E+02	3.3E+03	8.8E+02	5.3E+01	8.2E+01	3.8E+04	5.3E+01	8.2E+01
Total Petroleum Hydrocarbons	Not Determined	1.2E+03	4.1E+03	1.6E+03	6.8E+02	1.2E+03	4.6E+04	1.2E+03	1.2E+03
Trichloroethene	Not Determined	1.3E+00	3.2E+00	1.6E+00	3.7E+00	1.4E+01	2.5E+01	1.3E+00	1.4E+01
Vinyl Chloride	Not Determined	1.8E-02	6.0E-02	2.6E-02	1.2E-02	1.5E-02	5.9E-01	1.2E-02	1.5E-02

^a Distribution characterized using methods described by D'Agostino et al. (1990) (see Appendix B).

^b Statistics were calculated using one half the detection limit for nondetects.

NA Not applicable; value exceeds the maximum detected concentration.

Distributions were "Not Determined" if detection frequency < 50%.

Distributions which were "Not Determined" or "Undefined" were assumed to be lognormal.

TABLE 3-16
OPERABLE UNIT 1:
PRELIMINARY CHEMICALS OF INTEREST IN SURFACE SOIL^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Estimated Detects ^b	Detected Range (mg/kg)	
	Frequency	Greater Than 50%		Minimum	Maximum
Aroclor-1248	5/8	Yes		6.3E-01	3.9E+02
Arsenic	23/23	Yes	10	1.4E+00	1.2E+01
Benzo(a)Anthracene	1/2	Yes	1	3.9E-01	3.9E-01
Benzo(a)Pyrene	1/2	Yes	1	3.6E-01	3.6E-01
Benzo(b)Fluoranthene	1/2	Yes		5.4E-01	5.4E-01
Beryllium	12/23	Yes	11	2.8E-01	1.0E+00
Lead	24/24	Yes	9	3.3E+00	4.2E+02
Manganese	23/23	Yes	8	1.5E+02	4.9E+04
Nickel	23/23	Yes	8	6.0E+00	1.1E+03
Total Petroleum Hydrocarbons	14/20	Yes		6.3E+01	4.6E+04
Trichloroethene	4/28	No		1.1E-02	8.0E+00

^a Based on data from the following sample locations:

12-SB3	142-SS2	700_3-SB1	79-SS7	B-SS1
12-SS1 (1992)	142-SS3	703-SB1	79-SS8	J-SS1
12-SS1 (1994)	20-MW1S	703-SB9	79-SS9	K-SS1
136-S2	306-SB3	79-SS1	8-SB10	L-SS1
136-S3	505-SB8	79-SS2	8-SB11	T-SB1
136-SS1	507-SB1	79-SS3	8-SB12	W_6-MW1S
14-SS1	62_63-SB1	79-SS4	8-SB15	
14-SS2	64_68-SB1	79-SS5	8_12-SB13A	
142-SS1	70-SB1	79-SS6	8_12-SB14	

^b Value represents the number of detected samples which received a verification of "J".

TABLE 3-17
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF INORGANIC PCOIs IN
SURFACE SOIL TO BACKGROUND CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/kg)^a	UBL (mg/kg)^b	Above Background?
Arsenic	1.2E+01	1.1E+01	NO ^c
Beryllium	1.0E+00	2.1E+00	NO
Lead	4.2E+02	3.9E+01	YES
Manganese	4.9E+04	2.0E+03	YES
Nickel	1.1E+03	4.4E+01	YES

a Data from Table 3-16.

b Upper background levels (UBLs) for soil (see Table 3-6).

c Eliminated from further consideration since maximum concentration is within
Ohio farm soil background range (Cox and Colvin, 1996):
arsenic 0.5 to 56 mg/kg.

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-18
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF PCOLs IN
SURFACE SOIL TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above PRG?
	Site Maximum ^a	PRG ^b	
Aroclor-1248	3.9E+02	3.4E-01	Yes
Benzo(a)Anthracene	3.9E-01	2.6E+00	No
Benzo(a)Pyrene	3.6E-01	2.6E-01	Yes
Benzo(b)Fluoranthene	5.4E-01	2.6E+00	No
Lead	4.2E+02	1.0E+03	No
Manganese	4.9E+04	4.3E+04	Yes
Nickel	1.1E+03	3.4E+04	No
Total Petroleum Hydrocarbons	4.6E+04	3.6E+02^c	Yes
Trichloroethene	8.0E+00	7.0E+00	Yes

^a Data from Table 3-16.

^b Preliminary remediation goals (PRGs) for industrial soil (USEPA, 1996a).

^c Average PRG for total petroleum hydrocarbons (see Section 4.0).

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-19
OPERABLE UNIT 1:
EXPOSURE POINT CONCENTRATIONS FOR COIs IN SURFACE SOIL
GEAE EVENDALE
(Page 1 of 1)

Chemical	Distribution ^a	Statistics (mg/kg) ^b						Exposure Point	
		Arithmetic		95% UCL	Best Estimate	95% UCL	Maximum	Concentrations (mg/kg)	
		Mean	SD	Normal	of Mean	Lognormal	Detected	MLE	RME
Aroclor-1248	Lognormal	7.3E+01	1.3E+02	1.6E+02	NA	NA	3.9E+02	7.3E+01	3.9E+02
Benzo(a)Pyrene	Not Determined	NA	NA	NA	NA	NA	3.6E-01	3.6E-01	3.6E-01
Manganese	Lognormal	1.4E+04	1.8E+04	2.1E+04	3.1E+04	NA	4.9E+04	1.4E+04	4.9E+04
Total Petroleum Hydrocarbons	Lognormal	6.8E+03	1.1E+04	1.1E+04	3.4E+04	NA	4.6E+04	6.8E+03	4.6E+04
Trichloroethene	Not Determined	7.0E-01	2.0E+00	1.3E+00	5.7E-01	6.9E+00	8.0E+00	7.0E-01	6.9E+00

a Distribution characterized using methods described by D'Agostino et al. (1990) (see Appendix B).

b Statistics were calculated using one half the detection limit for nondetects.

NA Not applicable; value exceeds the maximum detected concentration.

Distributions were "Not Determined" if N < 8 or detection frequency < 50%.

Distributions which were "Not Determined" were assumed to be lognormal.

TABLE 3-20
OPERABLE UNIT 1:
PRELIMINARY CHEMICALS OF INTEREST IN SEDIMENT^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Detected Range (mg/kg)	
	Frequency	Greater Than 50%	Minimum	Maximum
Arsenic	3/3	Yes	4.6E+00	1.0E+01
Benzene	1/4	No	8.2E+02	8.2E+02
Ethylbenzene	1/4	No	8.4E+02	8.4E+02
Lead	3/3	Yes	7.6E+01	5.1E+02
Manganese	3/3	Yes	3.9E+02	1.1E+03
Toluene	1/4	No	3.8E+03	3.8E+03
Xylenes	1/4	No	6.2E+03	6.2E+03

a Based on data from the following sample locations:

122-SE3	124-SE1
123-SE2	500-1-SE7

TABLE 3-21
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF INORGANIC
PCOIs IN SEDIMENT TO BACKGROUND CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/kg)^a	UBL (mg/kg)^b	Above Background?
Arsenic	1.0E+01	1.1E+01	NO
Lead	5.1E+02	3.9E+01	YES
Manganese	1.1E+03	2.0E+03	NO

a Data from Table 3-20.

b Upper background levels (UBLs) for soil (see Table 3-6).

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-22
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF PCOIs IN
SEDIMENT TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above PRG?
	Site Maximum^a	PRG^b	
Benzene	8.2E+02	1.4E+00	Yes
Ethylbenzene	8.4E+02	2.3E+02	Yes
Lead	5.1E+02	1.0E+03	No
Toluene	3.8E+03	8.8E+02	Yes
Xylenes	6.2E+03	3.2E+02	Yes

^a Data from Table 3-20.

^b Preliminary remediation goals (PRGs) for industrial soil (USEPA, 1996a).

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-23
OPERABLE UNIT 1:
EXPOSURE POINT CONCENTRATIONS FOR COIs IN SEDIMENT
GEAE EVENDALE
(Page 1 of 1)

Chemical	Distribution ^a	Statistics (mg/kg) ^b					Exposure Point		
		Arithmetic		95% UCL Normal	Best Estimate of Mean	95% UCL Lognormal	Maximum Detected	Concentrations (mg/kg)	
		Mean	SD					MLE	RME
Benzene	Not Determined	2.1E+02	4.1E+02	6.9E+02	NA	NA	8.2E+02	2.1E+02	8.2E+02
Ethylbenzene	Not Determined	2.1E+02	4.2E+02	7.0E+02	NA	NA	8.4E+02	2.1E+02	8.4E+02
Toluene	Not Determined	9.5E+02	1.9E+03	3.2E+03	NA	NA	3.8E+03	9.5E+02	3.8E+03
Xylenes	Not Determined	1.6E+03	3.1E+03	5.2E+03	NA	NA	6.2E+03	1.6E+03	6.2E+03

a Distribution characterized using methods described by D'Agostino et al. (1990) (see Appendix B).

b Statistics were calculated using one half the detection limit for nondetects.

NA Not applicable; value exceeds the maximum detected concentration.

Distributions were "Not Determined" if N < 8.

Distributions which were "Not Determined" were assumed to be lognormal.

TABLE 3-24
OPERABLE UNIT 1:
PRELIMINARY CHEMICALS OF INTEREST
IN TOTAL SOIL (PROTECTION OF GW)^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Estimated	Detected Range (mg/kg)	
	Frequency	Greater Than 50%	Detects ^b	Minimum	Maximum
Aluminum	137/137	Yes	24	1.6E+03	2.5E+04
Antimony	80/137	Yes	52	1.0E-01	5.0E+01
Aroclor-1248	15/72	No		6.3E-01	3.9E+02
Aroclor-1254	4/72	No		1.8E+00	4.0E+00
Aroclor-1260	1/72	No		9.0E+00	9.0E+00
Arsenic	136/137	Yes	77	8.5E-01	2.4E+01
Benzene	11/292	No	1	6.0E-03	2.4E-01
Benzo(a)Anthracene	4/40	No	1	3.9E-01	2.9E+00
Cadmium	54/137	No	24	1.7E-01	3.2E+02
Cobalt	107/137	Yes	53	8.2E-01	1.3E+02
Copper	112/137	Yes	29	1.2E+00	5.1E+03
Cyanide	6/131	No		7.0E-01	1.5E+03
Dichloroethene, 1,2-	15/169	No	2	6.0E-03	1.2E+01
Ethylbenzene	12/292	No		1.1E-02	1.2E+01
Lead	145/161	Yes	54	2.0E+00	4.2E+02
Mercury	12/137	No		1.0E-01	1.2E+00
Methyl Ethyl Ketone	21/261	No		1.1E-02	1.8E+00
Methylene Chloride	11/287	No		6.0E-03	4.9E-01
Nickel	120/137	Yes	39	2.4E+00	3.8E+04
Tetrachloroethene	19/263	No	2	6.0E-03	3.6E+00
Thallium	39/137	No	37	9.3E-02	3.4E-01
Toluene	23/292	No	1	5.0E-03	4.8E+00
Total Petroleum Hydrocarbons	104/221	No		4.4E+01	4.6E+04
Trichloroethane, 1,1,1-	84/263	No	3	6.0E-03	3.0E+02
Trichloroethene	73/263	No	3	7.0E-03	2.5E+01
Vinyl Chloride	5/263	No	1	2.0E-02	5.9E-01

a Based on data from the following sample locations:

100-MW5S	14-SB2	21_22-SB2	503-SB4	507-SB4	703-SB4	8_12-SB13A	LD-SB2
12-SB1	14-SS1	21_22-SB3	503-SB5	507-SB5	703-SB5	8_12-SB14	LD-SB3
12-SB3	14-SS2	21_22-SB4	503-SB6	507-SB6	703-SB6	800_1-SB1	LD-SB4
12-SB3	142-SS1	21_22-SB5	503-SB7	507-SB7	703-SB7	86-MW4S	LD-SB5
12-SS1	142-SS2	301-SB1	505-SB1	507-SB8	703-SB8	87_88-SB1	LD-SB6
120-SB1	142-SS3	301-SB2	505-SB10	61_67-MW2S	703-SB9	93_94-MW2S	PST-SB1
120-SB10	16-MW2S	306-SB1	505-SB11	61_67-MW3S	77-SB1	95-MW3S	PST-SB2
120-SB2	16-MW3S	306-SB2	505-SB12	61_67-SB1	77-SB2	98_99-MW1S	PST-SB3
120-SB3	16-SB1	306-SB3	505-SB13	62_63-MW2S	79-SS1	B-SB1	PST-SB4
120-SB4	20-MW1S	306-SB4	505-SB14	62_63-MW3S	79-SS2	B-SS1	PST-SB5
120-SB5	20-SB1	306-SB5	505-SB15	62_63-MW4S	79-SS3	DS3-SB1	PST-SB6
120-SB6	20-SB10	32-SB1	505-SB2	62_63-SB1	79-SS4	H-SB1	PST-SB7
120-SB7	20-SB2	32-SB2	505-SB3	64_68-SB1	79-SS5	J-SB1	PST-SB8
120-SB8	20-SB3	46-SB1	505-SB4	64_68-SB2	79-SS6	J-SS1	PST-SB9
120-SB9	20-SB4	46-SB2	505-SB5	65-SB1	79-SS7	K-SB1	T-MW1S
122-SB1	20-SB5	46-SB3	505-SB6	65-SB2	79-SS8	K-SS1	T-SB1
123-MW1S	20-SB6	500_1-SB1	505-SB7	70-SB1	79-SS9	L-MW1S	W_4-SB1
124-MW1S	20-SB7	500_3-SB1	505-SB8	700_3-SB1	8-SB10	L-SB1	W_4-SB2
136-S2	20-SB8	500_4-SB1	505-SB9	700_4-SB1	8-SB11	L-SS1	W_5-SB1
136-S3	20-SB9	503-SB1	507-SB1	703-SB1	8-SB12	LD-MW2S	W_6-MW1S
136-SS1	21_22-MW1S	503-SB2	507-SB2	703-SB2	8-SB13	LD-MW3S	W_6-SB1
14-SB1	21_22-SB1	503-SB3	507-SB3	703-SB3	8-SB15	LD-SB1	WDA-SB1

b Value represents the number of detected samples which received a verification of "J".

TABLE 3-25
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF INORGANIC
PCOIs IN TOTAL SOIL (PROTECTION OF GW) TO
BACKGROUND CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/kg)^a	UBL (mg/kg)^b	Above Background?
Aluminum	2.5E+04	2.7E+04	NO
Antimony	5.0E+01	9.5E+00	YES
Arsenic	2.4E+01	1.1E+01	NO ^c
Cadmium	3.2E+02	NA	NA
Cobalt	1.3E+02	1.7E+01	YES
Copper	5.1E+03	3.3E+01	YES
Lead	4.2E+02	3.9E+01	YES
Mercury	1.2E+00	NA	NA
Nickel	3.8E+04	4.4E+01	YES
Thallium	3.4E-01	NA	NA

^a Data from Table 3-24.

^b Upper background levels (UBLs) for soil (see Table 3-6).

^c Eliminated from further consideration since maximum concentration is within
Ohio farm soil background range (Cox and Colvin, 1996):
arsenic 0.5 to 56 mg/kg.

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-26
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF PCOLs IN
TOTAL SOIL (PROTECTION OF GW) TO HEALTH-BASED
BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above SSL?
	Site Maximum ^a	SSL ^b	
Antimony	5.0E+01	5.0E+00	Yes
Aroclor-1248	3.9E+02	1.0E+00	Yes
Aroclor-1254	4.0E+00	1.0E+00	Yes
Aroclor-1260	9.0E+00	1.0E+00	Yes
Arsenic	2.4E+01	2.9E+01	No
Benzene	2.4E-01	3.0E-02	Yes
Benzo(a)Anthracene	2.9E+00	2.0E+00	Yes
Cadmium	3.2E+02	8.0E+00	Yes
Cobalt	1.3E+02	NA	NA
Copper	5.1E+03	NA	NA
Cyanide	1.5E+03	4.0E+01	Yes
Dichloroethene, 1,2-	1.2E+01	4.0E-01	Yes
Ethylbenzene	1.2E+01	1.3E+01	No
Lead	4.2E+02	4.0E+02	Yes
Mercury	1.2E+00	NA	NA
Methyl Ethyl Ketone	1.8E+00	NA	NA
Methylene Chloride	4.9E-01	2.0E-02	Yes
Nickel	3.8E+04	1.3E+02	Yes
Tetrachloroethene	3.6E+00	6.0E-02	Yes
Thallium	3.4E-01	7.0E-01	No
Toluene	4.8E+00	1.2E+01	No
Total Petroleum Hydrocarbons	4.6E+04	7.7E+01^c	Yes
Trichloroethane, 1,1,1-	3.0E+02	2.0E+00	Yes
Trichloroethene	2.5E+01	6.0E-02	Yes
Vinyl Chloride	5.9E-01	1.0E-02	Yes

^a Data from Table 3-24.

^b Soil screening levels (SSLs) for the protection of groundwater (USEPA, 1996b).

^c Average PRG for total petroleum hydrocarbons (see Section 4.0).

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-27
OPERABLE UNIT 1:
PRELIMINARY CHEMICALS OF INTEREST IN PERCHED GROUNDWATER^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Estimated	Detected Range (mg/L)	
	Frequency	Greater Than 50%	Detects ^b	Minimum	Maximum
Aroclor-1242	1/8	No		7.2E-04	7.2E-04
Aroclor-1248	2/8	No		2.0E-04	2.6E-02
Arsenic	13/19	Yes		8.5E-04	7.6E-02
Benzene	2/44	No		1.4E-01	2.0E-01
Bis(2-Ethylhexyl)Phthalate	3/10	No		8.4E-03	5.3E-01
Cadmium	10/19	Yes		5.5E-04	3.6E-03
Chromium	16/19	Yes		2.1E-05	1.3E+00
Dichloroethane, 1,2-	2/48	No		1.1E-02	1.2E-02
Dichloroethene, 1,1-	5/44	No		1.2E-03	1.5E-01
Dichloroethene, 1,2-	9/26	No		4.3E-03	1.1E-01
Dichloroethene, Cis-1,2-	1/10	No	1	1.9E-01	1.9E-01
Methylnaphthalene, 2-	1/10	No		5.0E-03	5.0E-03
N-Nitrosodiphenylamine	2/10	No		6.0E-03	1.6E-02
Naphthalene	1/10	No		1.1E-02	1.1E-02
Nickel	12/19	Yes		1.0E-02	7.9E-01
Tetrachloroethene	2/48	No		6.0E-03	2.1E-02
Total Petroleum Hydrocarbons	10/28	No		2.0E+00	1.1E+03
Trichloroethane, 1,1,1-	16/48	No	4	1.4E-03	1.1E+01
Trichloroethane, 1,1,2-	2/48	No		6.0E-03	1.1E-02
Trichloroethene	20/48	No	1	3.8E-03	3.6E+00
Vinyl Acetate	3/48	No		1.3E-02	2.5E+00
Vinyl Chloride	1/42	No		9.4E-03	9.4E-03

^a Based on data from the following sample locations:

100-MW-5S	21_22-MW-1S	62_63-MW-4S	98_99-MW-1S	PST-MW-1S
123-MW-1S	32-MW-1S	64_68-MW-1S	GM-2	PST-MW-2S
124-MW-1S	61_67-MW-1S	65-MW-1S	GM-4	PST-MW-3S
16-MW-1S	61_67-MW-2S	70-MW-1S	GM-9P	T-MW-1S
16-MW-2S	61_67-MW-3S	8-AREA 509	L-MW-1S	W_4-MW-1S
16-MW-3S	62_63-MW-1S	86-MW-4S	LD-MW-1S	W6-MW-1S
20-MW-1S	62_63-MW-2S	93_94-MW-2S	LD-MW-2S	
20-MW-3S	62_63-MW-3S	95-MW-3S	LD-MW-3S	

^b Value represents the number of detected samples which received a verification of "J".

TABLE 3-28
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF INORGANIC PCOIs
IN PERCHED GROUNDWATER TO BACKGROUND
CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/L)^a	UBL (mg/L)^b	Above Background?
Arsenic	7.6E-02	5.1E-02	YES
Cadmium	3.6E-03	6.9E-03	NO
Chromium	1.3E+00	2.1E-01	YES
Nickel	7.9E-01	1.6E-01	YES

a Data from Table 3-27.

b Upper background levels (UBLs) for perched groundwater (see Table 3-7).

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-29
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF PCOIs IN PERCHED
GROUNDWATER TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/L)		Above Benchmark?
	Site Maximum ^a	Benchmark ^b	
Aroclor-1242	7.2E-04	5.0E-04	Yes
Aroclor-1248	2.6E-02	5.0E-04	Yes
Arsenic	7.6E-02	5.0E-02	Yes
Benzene	2.0E-01	5.0E-03	Yes
Bis(2-Ethylhexyl)Phthalate	5.3E-01	4.8E-03	Yes
Chromium	1.3E+00	1.0E-01	Yes
Dichloroethane, 1,2-	1.2E-02	5.0E-03	Yes
Dichloroethene, 1,1-	1.5E-01	7.0E-03	Yes
Dichloroethene, 1,2-	1.1E-01	7.0E-02	Yes
Dichloroethene, Cis-1,2-	1.9E-01	7.0E-02	Yes
Methylnaphthalene, 2-	5.0E-03	2.4E-01	No
N-Nitrosodiphenylamine	1.6E-02	1.4E-02	Yes
Naphthalene	1.1E-02	2.4E-01	No
Nickel	7.9E-01	1.0E-01	Yes
Tetrachloroethene	2.1E-02	5.0E-03	Yes
Total Petroleum Hydrocarbons	1.1E+03	8.0E-01	Yes
Trichloroethane, 1,1,1-	1.1E+01	2.0E-01	Yes
Trichloroethane, 1,1,2-	1.1E-02	5.0E-03	Yes
Trichloroethene	3.6E+00	5.0E-03	Yes
Vinyl Acetate	2.5E+00	4.1E-01	Yes
Vinyl Chloride	9.4E-03	2.0E-03	Yes

^a Data from Table 3-27.

^b See Table 3-11 for source.

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-30
OPERABLE UNIT 1:
EXPOSURE POINT CONCENTRATIONS FOR COIs IN PERCHED GROUNDWATER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Distribution ^a	Statistics (mg/L) ^b						Exposure Point Concentrations (mg/L)	
		Arithmetic		95% UCL	Best Estimate	95% UCL	Maximum	MLE	RME
		Mean	SD	Normal	of Mean	Lognormal	Detected		
Aroclor-1242	Not Determined	2.0E-04	2.4E-04	3.6E-04	2.3E-04	NA	7.2E-04	2.0E-04	7.2E-04
Aroclor-1248	Not Determined	3.4E-03	9.1E-03	9.5E-03	2.3E-03	NA	2.6E-02	3.4E-03	2.6E-02
Arsenic	Undefined	1.0E-02	1.8E-02	1.7E-02	5.4E-02	NA	7.6E-02	1.0E-02	7.6E-02
Benzene	Not Determined	1.4E-02	4.0E-02	2.4E-02	6.9E-03	1.0E-02	2.0E-01	6.9E-03	1.0E-02
Bis(2-Ethylhexyl)Phthalate	Not Determined	9.2E-02	1.9E-01	2.0E-01	7.3E-02	NA	5.3E-01	9.2E-02	5.3E-01
Chromium	Undefined	1.0E-01	2.9E-01	2.2E-01	4.5E-01	NA	1.3E+00	1.0E-01	1.3E+00
Dichloroethane, 1,2-	Not Determined	NA	NA	NA	NA	NA	1.2E-02	1.2E-02	1.2E-02
Dichloroethene, 1,1-	Not Determined	1.0E-02	2.9E-02	1.8E-02	6.1E-03	8.7E-03	1.5E-01	6.1E-03	8.7E-03
Dichloroethene, 1,2-	Not Determined	4.4E-02	1.1E-01	8.0E-02	3.0E-02	8.8E-02	1.1E-01	4.4E-02	8.8E-02
Dichloroethene, Cis-1,2-	Not Determined	2.2E-02	5.9E-02	5.6E-02	1.1E-02	6.3E-02	1.9E-01	2.2E-02	6.3E-02
N-Nitrosodiphenylamine	Not Determined	6.2E-03	3.5E-03	8.2E-03	6.1E-03	7.9E-03	1.6E-02	6.2E-03	7.9E-03
Nickel	Undefined	6.8E-02	1.8E-01	1.4E-01	3.7E-01	NA	7.9E-01	6.8E-02	7.9E-01
Tetrachloroethene	Not Determined	NA	NA	NA	1.5E-02	NA	2.1E-02	2.1E-02	2.1E-02
Total Petroleum Hydrocarbons	Not Determined	5.6E+01	2.1E+02	1.2E+02	3.2E+01	2.2E+02	1.1E+03	5.6E+01	2.2E+02
Trichloroethane, 1,1,1-	Not Determined	6.1E-01	2.2E+00	1.1E+00	2.4E-01	1.0E+00	1.1E+01	6.1E-01	1.0E+00
Trichloroethane, 1,1,2-	Not Determined	NA	NA	NA	NA	NA	1.1E-02	1.1E-02	1.1E-02
Trichloroethene	Not Determined	1.9E-01	6.2E-01	3.5E-01	1.2E-01	3.7E-01	3.6E+00	1.9E-01	3.7E-01
Vinyl Acetate	Not Determined	1.1E-01	3.9E-01	2.0E-01	3.3E-02	6.5E-02	2.5E+00	3.3E-02	6.5E-02
Vinyl Chloride	Not Determined	5.9E-03	3.3E-03	6.8E-03	5.8E-03	6.3E-03	9.4E-03	5.9E-03	6.3E-03

^a Distribution characterized using methods described by D'Agostino et al. (1990) (see Appendix B).

^b Statistics were calculated using one half the detection limit for nondetects.

NA Not applicable; value exceeds the maximum detected concentration.

Distributions were "Not Determined" if detection frequency < 50%.

Distributions which were "Not Determined" or "Undefined" were assumed to be lognormal.

TABLE 3-31
OPERABLE UNIT 1:
PRELIMINARY CHEMICALS OF INTEREST IN
UPPER SAND AND GRAVEL GROUNDWATER^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Estimated	Detected Range (mg/L)	
	Frequency	Greater Than 50%	Detects ^b	Minimum	Maximum
Bis(2-Ethylhexyl)Phthalate	1/4	No	1	2.6E-03	2.6E-03
Cadmium	2/7	No	1	1.0E-03	1.3E-02
Carbon Disulfide	1/8	No	1	2.2E-03	2.2E-03
Chromium	6/7	Yes	1	2.3E-05	1.5E+01
Dichloroethane, 1,1-	7/8	Yes	2	2.4E-03	6.2E+00
Dichloroethane, 1,2-	2/8	No	1	3.7E-03	1.0E-02
Dichloroethene, 1,1-	2/8	No		5.3E-03	1.0E-01
Dichloroethene, 1,2-	1/2	Yes		1.2E-01	1.2E-01
Dichloroethene, Cis-1,2-	2/2	Yes	1	1.1E-03	1.8E-02
Dichloroethene, Trans-1,2-	4/6	Yes	1	8.3E-04	7.2E-01
N-Nitrosodiphenylamine	2/4	Yes		1.1E-02	1.5E-02
Nickel	3/7	No		4.0E-05	1.6E+00
Tetrachloroethene	1/8	No	1	1.5E-03	1.5E-03
Trichloroethane, 1,1,1-	2/8	No	1	1.1E-03	1.6E-01
Trichloroethene	1/8	No		2.9E-01	2.9E-01

^a Based on data from the following sample locations:

GM-3S GM-8S
GM-5S GM-9S

^b Value represents the number of detected samples which received a verification of "J".

TABLE 3-32
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF INORGANIC PCOLs IN
UPPER SAND AND GRAVEL GROUNDWATER TO
BACKGROUND CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/L)^a	UBL (mg/L)^b	Above Background?
Cadmium	1.3E-02	NA	NA
Chromium	1.5E+01	2.2E-01	YES
Nickel	1.6E+00	1.3E-01	YES

a Data from Table 3-31.

b Upper background levels (UBLs) for upper sand and gravel groundwater (see Table 3-8).

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-33
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF PCOIs IN UPPER SAND
AND GRAVEL GROUNDWATER TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/L)		Above Benchmark?
	Site Maximum ^a	Benchmark ^b	
Bis(2-Ethylhexyl)Phthalate	2.6E-03	4.8E-03	No
Cadmium	1.3E-02	5.0E-03	Yes
Carbon Disulfide	2.2E-03	2.1E-02	No
Chromium	1.5E+01	1.0E-01	Yes
Dichloroethane, 1,1-	6.2E+00	8.1E-01	Yes
Dichloroethane, 1,2-	1.0E-02	5.0E-03	Yes
Dichloroethene, 1,1-	1.0E-01	7.0E-03	Yes
Dichloroethene, 1,2-	1.2E-01	7.0E-02	Yes
Dichloroethene, Cis-1,2-	1.8E-02	7.0E-02	No
Dichloroethene, Trans-1,2-	7.2E-01	1.0E-01	Yes
N-Nitrosodiphenylamine	1.5E-02	1.4E-02	Yes
Nickel	1.6E+00	1.0E-01	Yes
Tetrachloroethene	1.5E-03	5.0E-03	No
Trichloroethane, 1,1,1-	1.6E-01	2.0E-01	No
Trichloroethene	2.9E-01	5.0E-03	Yes

^a Data from Table 3-31.

^b See Table 3-11 for source.

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-34
OPERABLE UNIT 1:
PRELIMINARY CHEMICALS OF INTEREST
IN LOWER SAND AND GRAVEL GROUNDWATER^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Estimated Detects ^b	Detected Range (mg/L)	
	Frequency	Greater Than 50 %		Minimum	Maximum
Chromium	6/7	Yes		1.0E-02	2.8E-01
Dichloroethene, Cis-1,2-	2/2	Yes	1	2.2E-03	1.2E-02
Nickel	3/7	No	1	2.0E-02	6.5E-02
Trichloroethene	1/7	No		1.2E-02	1.2E-02
Vinyl Chloride	1/7	No	1	3.6E-03	3.6E-03

^a Based on data from the following sample locations:

20-MW-3D GM-8D
GM-3D GM-9D
GM-5D

^b Value represents the number of detected samples which received a verification of "J".

TABLE 3-35
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF INORGANIC
PCOIs IN LOWER SAND AND GRAVEL GROUNDWATER
TO BACKGROUND CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/L)^a	UBL (mg/L)^b	Above Background?
Chromium	2.8E-01	7.1E-02	YES
Nickel	6.5E-02	NA	NA

a Data from Table 3-34.

b Upper background levels (UBLs) for lower sand and gravel groundwater (see Table 3-9).

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-36
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF PCOLs IN
LOWER SAND AND GRAVEL GROUNDWATER TO
HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/L)		Above Benchmark?
	Site Maximum^a	Benchmark^b	
Chromium	2.8E-01	1.0E-01	Yes
Dichloroethene, Cis-1,2-	1.2E-02	7.0E-02	No
Nickel	6.5E-02	1.0E-01	No
Trichloroethene	1.2E-02	5.0E-03	Yes
Vinyl Chloride	3.6E-03	2.0E-03	Yes

a Data from Table 3-34.

b See Table 3-11 for source.

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-37
OPERABLE UNIT 2:
PRELIMINARY CHEMICALS OF INTEREST IN TOTAL SOIL^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection Frequency	Detection Frequency Greater Than 50%	Estimated Detects ^b	Detected Range (mg/kg)	
	Frequency			Minimum	Maximum
Arsenic	2/2	Yes		4.2E+00	4.4E+00
Benzene	1/72	No	1	1.8E+00	1.8E+00
Beryllium	1/2	Yes	1	9.6E-01	9.6E-01
Lead	2/2	Yes		2.5E+00	1.5E+01
Manganese	2/2	Yes		2.0E+02	1.4E+03
Nickel	2/2	Yes	1	6.6E+00	2.3E+01
Total Petroleum Hydrocarbons	47/70	Yes		1.1E+01	8.0E+03
Trichloroethene	8/72	No		6.0E-03	4.1E+00

^a Based on data from the following sample locations:

141-SD-26-SB01	ST-08-SB-01	ST-31-SB-08	ST-33-SB-01
42-SS-20-SB-01	ST-09-SB-01	ST-31-SB-09	U-SS-30-SB-01
72-ST-14-SB-01	ST-10-SB-01	ST-31-SB-10	U-SS-30-SB-02
A-SS-27-SB-01	ST-12-SB-01	ST-31-SB-18	W10-ST-15-SB-01
A-SS-27-SB-02	ST-13-SB-01	ST-31-SB-19	W10-ST-16-SB-01
I-SS-29-SB-01	ST-31-SB-04	ST-31-SB-23	W10-ST-17-SB-01
I-SS-29-SB-02	ST-31-SB-05	ST-31-SB-24	W10-ST-18-SB-01
ST-03-SB-01	ST-31-SB-06	ST-32-SB-01	W10-ST-19-SB-01

^b Value represents the number of detected samples which received a verification of "J".

TABLE 3-38
OPERABLE UNIT 2:
COMPARISON OF CONCENTRATIONS OF INORGANIC
PCOIs IN TOTAL SOIL TO BACKGROUND
CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/kg)^a	UBL (mg/kg)^b	Above Background?
Arsenic	4.4E+00	1.1E+01	NO
Beryllium	9.6E-01	2.1E+00	NO
Lead	1.5E+01	3.9E+01	NO
Manganese	1.4E+03	2.0E+03	NO
Nickel	2.3E+01	4.4E+01	NO

a Data from Table 3-37.

b Upper background levels (UBLs) for soil (see Table 3-6).

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-39
OPERABLE UNIT 2:
COMPARISON OF CONCENTRATIONS OF PCOIs IN TOTAL
SOIL TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above PRG?
	Site Maximum^a	PRG^b	
Benzene	1.8E+00	1.4E+00	Yes
Total Petroleum Hydrocarbons	8.0E+03	3.6E+02^c	Yes
Trichloroethene	4.1E+00	7.0E+00	No

^a Data from Table 3-37.

^b Preliminary remediation goals (PRGs) for industrial soil (USEPA, 1996a).

^c Average PRG for total petroleum hydrocarbons (see Section 4.0).

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-40
OPERABLE UNIT 2:
EXPOSURE POINT CONCENTRATIONS FOR COIs IN TOTAL SOIL
GEAE EVENDALE
(Page 1 of 1)

Chemical	Distribution ^a	Statistics (mg/kg) ^b					Maximum Detected	Exposure Point Concentrations (mg/kg)	
		Arithmetic Mean	SD	95% UCL Normal	Best Estimate of Mean	95% UCL Lognormal		MLE	RME
Benzene	Not Determined	1.5E-01	5.8E-01	2.7E-01	3.0E-02	5.6E-02	1.8E+00	3.0E-02	5.6E-02
Total Petroleum Hydrocarbons	Undefined	9.4E+02	1.8E+03	1.3E+03	2.4E+03	NA	8.0E+03	9.4E+02	8.0E+03

a Distribution characterized using methods described by D'Agostino et al. (1990) (see Appendix B).

b Statistics were calculated using one half the detection limit for nondetects.

NA Not applicable; value exceeds the maximum detected concentration.

Distributions were "Not Determined" if detection frequency < 50%.

Distributions which were "Not Determined" or "Undefined" were assumed to be lognormal.

TABLE 3-41
OPERABLE UNIT 2:
PRELIMINARY CHEMICALS OF INTEREST IN SURFACE SOIL^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Detected Range (mg/kg)	
	Frequency	Greater Than 50%	Minimum	Maximum
Total Petroleum Hydrocarbons	4/8	Yes	8.3E+01	2.5E+03
Trichloroethene	1/7	No	3.5E-02	3.5E-02

^a Based on data from the following sample locations:

72-ST-14-SB-01	ST-09-SB-01	ST-31-SB-08
A-SS-27-SB-01	ST-10-SB-01	W10-ST-19-SB-01
A-SS-27-SB-02	ST-12-SB-01	

TABLE 3-42
OPERABLE UNIT 2:
COMPARISON OF CONCENTRATIONS OF PCOLs IN
SURFACE SOIL TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above PRG?
	Site Maximum^a	PRG^b	
Total Petroleum Hydrocarbons	2.5E+03	3.6E+02^c	Yes
Trichloroethene	3.5E-02	7.0E+00	No

a Data from Table 3-41.

b Preliminary remediation goals (PRGs) for industrial soil (USEPA, 1996a).

c Average PRG for total petroleum hydrocarbons (see Section 4.0).

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-43
OPERABLE UNIT 2:
EXPOSURE POINT CONCENTRATIONS FOR COIs IN SURFACE SOIL
GEAE EVENDALE
(Page 1 of 1)

Chemical	Distribution ^a	Statistics (mg/kg) ^b						Exposure Point Concentrations (mg/kg)	
		Arithmetic Mean	SD	95% UCL Normal	Best Estimate of Mean	95% UCL Lognormal	Maximum Detected	MLE	RME
Total Petroleum Hydrocarbons	Lognormal	4.0E+02	8.7E+02	9.8E+02	8.6E+02	NA	2.5E+03	4.0E+02	2.5E+03

^a Distribution characterized using methods described by D'Agostino et al. (1990) (see Appendix B).

^b Statistics were calculated using one half the detection limit for nondetects.

NA Not applicable; value exceeds the maximum detected concentration.

TABLE 3-44
OPERABLE UNIT 2:
PRELIMINARY CHEMICALS OF INTEREST IN SEDIMENT^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Estimated Detects ^b	Detected Range (mg/kg)	
	Frequency	Greater Than 50%		Minimum	Maximum
Arsenic	22/24	Yes	2	3.8E+00	2.7E+01
Benzene	2/25	No		1.3E+01	1.0E+02
Ethylbenzene	1/25	No		8.9E+01	8.9E+01
Lead	24/24	Yes		1.5E+01	1.8E+03
Manganese	24/24	Yes		6.9E+01	8.2E+04
Toluene	4/25	No		1.3E+00	4.7E+02
Xylenes	3/25	No		7.2E+01	5.8E+02

a Based on data from the following sample locations:

117-SD-22-001	119-SD-24-002	119-SD-24-009	127-SD-25-001
117-SD-22-002	119-SD-24-003	119-SD-24-011	127-SD-25-002
117-SD-22-003	119-SD-24-004	119-SD-24-012	127-SD-25-003
118-SD-23-001	119-SD-24-005	119-SD-24-013	141-SD-26-001
118-SD-23-003	119-SD-24-006	119-SD-24-014	
118-SD-23-005	119-SD-24-007	119-SD-24-015	
119-SD-24-001	119-SD-24-008	119-SD-24-016	

b Value represents the number of detected samples which received a verification of "J".

TABLE 3-45
OPERABLE UNIT 2:
COMPARISON OF CONCENTRATIONS OF
INORGANIC PCOLs IN SEDIMENT TO BACKGROUND
CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/kg)^a	UBL (mg/kg)^b	Above Background?
Arsenic	2.7E+01	1.1E+01	NO ^c
Lead	1.8E+03	3.9E+01	YES
Manganese	8.2E+04	2.0E+03	YES

a Data from Table 3-44.

b Upper background levels (UBLs) for soil (see Table 3-6).

c Eliminated from further consideration since maximum concentration is within
Ohio farm soil background range (Cox and Colvin, 1996):
arsenic 0.5 to 56 mg/kg.

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-46
OPERABLE UNIT 2:
COMPARISON OF CONCENTRATIONS OF PCOLs IN
SEDIMENT TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above PRG?
	Site Maximum ^a	PRG ^b	
Benzene	1.0E+02	1.4E+00	Yes
Ethylbenzene	8.9E+01	2.3E+02	No
Lead	1.8E+03	1.0E+03	Yes
Manganese	8.2E+04	4.3E+04	Yes
Toluene	4.7E+02	8.8E+02	No
Xylenes	5.8E+02	3.2E+02	Yes

a Data from Table 3-44.

b Preliminary remediation goals (PRGs) for industrial soil (USEPA, 1996a).

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-47
OPERABLE UNIT 2:
EXPOSURE POINT CONCENTRATIONS FOR COIs IN SEDIMENT
GEAE EVENDALE
(Page 1 of 1)

Chemical	Distribution ^a	Statistics (mg/kg) ^b						Exposure Point	
		Arithmetic Mean	SD	95% UCL Normal	Best Estimate of Mean	95% UCL Lognormal	Maximum Detected	Concentrations (mg/kg) MLE	RME
Benzene	Not Determined	4.9E+00	2.0E+01	1.2E+01	9.9E-01	3.0E+01	1.0E+02	4.9E+00	3.0E+01
Lead	Lognormal	4.2E+02	5.1E+02	6.0E+02	4.9E+02	1.1E+03	1.8E+03	4.2E+02	1.1E+03
Manganese	Undefined	4.1E+03	1.7E+04	9.9E+03	1.4E+03	3.2E+03	8.2E+04	1.4E+03	3.2E+03
Xylenes	Not Determined	3.0E+01	1.2E+02	7.0E+01	9.3E+00	NA	5.8E+02	3.0E+01	5.8E+02

a Distribution characterized using methods described by D'Agostino et al. (1990) (see Appendix B).

b Statistics were calculated using one half the detection limit for nondetects.

NA Not applicable; value exceeds the maximum detected concentration.

Distributions were "Not Determined" if detection frequency < 50%.

Distributions which were "Not Determined" or "Undefined" were assumed to be lognormal.

TABLE 3-48
OPERABLE UNIT 2:
PRELIMINARY CHEMICALS OF INTEREST
IN TOTAL SOIL (PROTECTION OF GW)^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Estimated Detects ^b	Detected Range (mg/kg)	
	Frequency	Greater Than 50%		Minimum	Maximum
Aluminum	2/2	Yes		2.1E+03	1.9E+04
Arsenic	2/2	Yes		4.2E+00	4.4E+00
Benzene	1/72	No	1	1.8E+00	1.8E+00
Cadmium	2/2	Yes		1.7E+00	4.7E+00
Cobalt	1/2	Yes	1	1.1E+01	1.1E+01
Copper	2/2	Yes	1	3.4E+00	2.0E+01
Dichloroethene, Cis-1,2-	5/72	No		6.0E-03	9.5E-01
Ethylbenzene	6/72	No		3.2E-02	3.3E+01
Lead	2/2	Yes		2.5E+00	1.5E+01
Methyl Ethyl Ketone	1/73	No		3.1E-02	3.1E-02
Nickel	2/2	Yes	1	6.6E+00	2.3E+01
Tetrachloroethene	5/72	No		1.7E-02	1.2E-01
Toluene	4/72	No		1.3E-02	5.1E+01
Total Petroleum Hydrocarbons	47/70	Yes		1.1E+01	8.0E+03
Trichloroethane, 1,1,1-	6/72	No		7.0E-03	6.5E-01
Trichloroethene	8/72	No		6.0E-03	4.1E+00

^a Based on data from the following sample locations:

141-SD-26-SB01	ST-08-SB-01	ST-31-SB-08	ST-33-SB-01
42-SS-20-SB-01	ST-09-SB-01	ST-31-SB-09	U-SS-30-SB-01
72-ST-14-SB-01	ST-10-SB-01	ST-31-SB-10	U-SS-30-SB-02
A-SS-27-SB-01	ST-12-SB-01	ST-31-SB-18	W10-ST-15-SB-01
A-SS-27-SB-02	ST-13-SB-01	ST-31-SB-19	W10-ST-16-SB-01
I-SS-29-SB-01	ST-31-SB-04	ST-31-SB-23	W10-ST-17-SB-01
I-SS-29-SB-02	ST-31-SB-05	ST-31-SB-24	W10-ST-18-SB-01
ST-03-SB-01	ST-31-SB-06	ST-32-SB-01	W10-ST-19-SB-01

^b Value represents the number of detected samples which received a verification of "J".

TABLE 3-49
OPERABLE UNIT 2:
COMPARISON OF CONCENTRATIONS OF INORGANIC
PCOIs IN TOTAL SOIL (PROTECTION OF GW) TO
BACKGROUND CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/kg)^a	UBL (mg/kg)^b	Above Background?
Aluminum	1.9E+04	2.7E+04	NO
Arsenic	4.4E+00	1.1E+01	NO
Cadmium	4.7E+00	NA	NA
Cobalt	1.1E+01	1.7E+01	NO
Copper	2.0E+01	3.3E+01	NO
Lead	1.5E+01	3.9E+01	NO
Nickel	2.3E+01	4.4E+01	NO

a Data from Table 3-48.

b Upper background levels (UBLs) for soil (see Table 3-6).

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-50
OPERABLE UNIT 2:
COMPARISON OF CONCENTRATIONS OF PCOLs IN TOTAL SOIL
(PROTECTION OF GW) TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above SSL?
	Site Maximum ^a	SSL ^b	
Benzene	1.8E+00	3.0E-02	Yes
Cadmium	4.7E+00	8.0E+00	No
Dichloroethene, Cis-1,2-	9.5E-01	4.0E-01	Yes
Ethylbenzene	3.3E+01	1.3E+01	Yes
Methyl Ethyl Ketone	3.1E-02	NA	NA
Tetrachloroethene	1.2E-01	6.0E-02	Yes
Toluene	5.1E+01	1.2E+01	Yes
Total Petroleum Hydrocarbons	8.0E+03	7.7E+01^c	Yes
Trichloroethane, 1,1,1-	6.5E-01	2.0E+00	No
Trichloroethene	4.1E+00	6.0E-02	Yes

^a Data from Table 3-48.

^b Soil screening levels (SSLs) for the protection of groundwater (USEPA, 1996b).

^c Average SSL for total petroleum hydrocarbons (see Section 4.0).

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-51
OPERABLE UNIT 2:
PRELIMINARY CHEMICALS OF INTEREST IN PERCHED GROUNDWATER^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection Frequency	Detection Frequency Greater Than 50%	Estimated Detects ^b	Detected Range (mg/L)	
				Minimum	Maximum
Arsenic	7/14	Yes	3	3.1E-03	2.0E-02
Benzene	2/23	No		6.5E-03	8.0E-03
Bis(2-Ethylhexyl)Phthalate	5/14	No		1.0E-03	1.0E-02
Cadmium	1/14	No		1.3E-02	1.3E-02
Chromium	11/14	Yes	4	6.8E-03	3.4E-01
Dibenzofuran	1/14	No		3.0E-01	3.0E-01
Dichloroethane, 1,2-	4/24	No		2.5E-03	7.0E-03
Dichloroethene, 1,1-	10/24	No		4.0E-03	1.2E-01
Dichloroethene, Cis-1,2-	12/25	No		3.0E-03	2.4E-01
Fluorene	1/14	No		5.5E-01	5.5E-01
Methylene Chloride	6/25	No		1.4E-03	2.7E-02
Methylnaphthalene, 2-	3/14	No		1.3E-02	1.1E+01
Naphthalene	1/14	No		3.0E+00	3.0E+00
Nickel	6/14	No		5.2E-02	8.3E-01
Phenanthrene	1/14	No		1.3E+00	1.3E+00
Tetrachloroethene	5/24	No		2.0E-03	5.2E-02
Total Petroleum Hydrocarbons	2/2	Yes		1.1E+00	1.7E+05
Trichloroethane, 1,1,1-	13/25	Yes		3.3E-02	9.1E-01
Trichloroethene	14/25	Yes		7.0E-02	2.2E+00
Vinyl Chloride	4/22	No		5.0E-03	3.3E-02

^a Based on data from the following sample locations:

AF-01P	AF-04P	AF-07P	AF-12P	AF-16P
AF-02P	AF-05P	AF-08P	AF-13P	AF-17P
AF-03P	AF-06P	AF-10P	AF-14P	AF-18P

^b Value represents the number of detected samples which received a verification of "J".

TABLE 3-52
OPERABLE UNIT 2:
COMPARISON OF CONCENTRATIONS OF INORGANIC PCOIs IN
PERCHED GROUNDWATER TO BACKGROUND
CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/L)^a	UBL (mg/L)^b	Above Background?
Arsenic	2.0E-02	5.1E-02	NO
Cadmium	1.3E-02	6.9E-03	YES
Chromium	3.4E-01	2.1E-01	YES
Nickel	8.3E-01	1.6E-01	YES

a Data from Table 3-51.

b Upper background levels (UBLs) for perched groundwater (see Table 3-7).

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-53
OPERABLE UNIT 2:
COMPARISON OF CONCENTRATIONS OF PCOLs IN PERCHED
GROUNDWATER TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/L)		Above Benchmark?
	Site Maximum ^a	Benchmark ^b	
Benzene	8.0E-03	5.0E-03	Yes
Bis(2-Ethylhexyl)Phthalate	1.0E-02	4.8E-03	Yes
Cadmium	1.3E-02	5.0E-03	Yes
Chromium	3.4E-01	1.0E-01	Yes
Dibenzofuran	3.0E-01	2.4E-02	Yes
Dichloroethane, 1,2-	7.0E-03	5.0E-03	Yes
Dichloroethene, 1,1-	1.2E-01	7.0E-03	Yes
Dichloroethene, Cis-1,2-	2.4E-01	7.0E-02	Yes
Fluorene	5.5E-01	2.4E-01	Yes
Methylene Chloride	2.7E-02	5.0E-03	Yes
Methylnaphthalene, 2-	1.1E+01	2.4E-01	Yes
Naphthalene	3.0E+00	2.4E-01	Yes
Nickel	8.3E-01	1.0E-01	Yes
Phenanthrene	1.3E+00	1.8E-01	Yes
Tetrachloroethene	5.2E-02	5.0E-03	Yes
Total Petroleum Hydrocarbons	1.7E+05	8.0E-01	Yes
Trichloroethane, 1,1,1-	9.1E-01	2.0E-01	Yes
Trichloroethene	2.2E+00	5.0E-03	Yes
Vinyl Chloride	3.3E-02	2.0E-03	Yes

a Data from Table 3-51.

b See Table 3-11 for source.

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-54
OPERABLE UNIT 2:
EXPOSURE POINT CONCENTRATIONS FOR COIs IN PERCHED GROUNDWATER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Distribution ^a	Statistics (mg/L) ^b						Exposure Point	
		Arithmetic		95% UCL	Best Estimate	95% UCL	Maximum	Concentrations (mg/L)	
		Mean	SD	Normal	of Mean	Lognormal	Detected	MLE	RME
Benzene	Not Determined	2.8E-03	1.4E-03	3.4E-03	2.8E-03	3.3E-03	8.0E-03	2.8E-03	3.3E-03
Bis(2-Ethylhexyl)Phthalate	Not Determined	NA	NA	NA	NA	NA	1.0E-02	1.0E-02	1.0E-02
Cadmium	Not Determined	2.8E-03	2.8E-03	4.1E-03	2.6E-03	3.4E-03	1.3E-02	2.8E-03	3.4E-03
Chromium	Lognormal	5.9E-02	9.6E-02	1.0E-01	6.7E-02	NA	3.4E-01	5.9E-02	3.4E-01
Dibenzofuran	Not Determined	2.6E-02	7.9E-02	6.3E-02	1.2E-02	3.0E-02	3.0E-01	2.6E-02	3.0E-02
Dichloroethane, 1,2-	Not Determined	NA	NA	NA	NA	NA	7.0E-03	7.0E-03	7.0E-03
Dichloroethene, 1,1-	Not Determined	1.7E-02	3.1E-02	2.8E-02	1.4E-02	3.2E-02	1.2E-01	1.7E-02	3.2E-02
Dichloroethene, Cis-1,2-	Not Determined	8.2E-02	2.5E-01	1.7E-01	6.6E-02	NA	2.4E-01	8.2E-02	2.4E-01
Fluorene	Not Determined	4.4E-02	1.5E-01	1.1E-01	1.5E-02	4.8E-02	5.5E-01	4.4E-02	4.8E-02
Methylene Chloride	Not Determined	NA	NA	NA	9.5E-03	2.3E-02	2.7E-02	9.5E-03	2.3E-02
Methylnaphthalene, 2-	Not Determined	7.9E-01	2.9E+00	2.2E+00	8.7E-02	1.4E+00	1.1E+01	7.9E-01	1.4E+00
Naphthalene	Not Determined	2.2E-01	8.0E-01	6.0E-01	3.4E-02	2.4E-01	3.0E+00	2.2E-01	2.4E-01
Nickel	Not Determined	1.1E-01	2.2E-01	2.1E-01	1.1E-01	NA	8.3E-01	1.1E-01	8.3E-01
Phenanthrene	Not Determined	9.8E-02	3.5E-01	2.6E-01	2.2E-02	1.0E-01	1.3E+00	9.8E-02	1.0E-01
Tetrachloroethene	Not Determined	NA	NA	NA	9.9E-03	2.5E-02	5.2E-02	9.9E-03	2.5E-02
Total Petroleum Hydrocarbons	Not Determined	8.5E+04	1.2E+05	NA	NA	NA	1.7E+05	8.5E+04	1.7E+05
Trichloroethane, 1,1,1-	Lognormal	1.8E-01	3.0E-01	2.8E-01	4.4E-01	NA	9.1E-01	1.8E-01	9.1E-01
Trichloroethene	Lognormal	4.2E-01	5.5E-01	6.1E-01	NA	NA	2.2E+00	4.2E-01	2.2E+00
Vinyl Chloride	Not Determined	6.2E-03	6.2E-03	8.5E-03	6.0E-03	7.9E-03	3.3E-02	6.2E-03	7.9E-03

^a Distribution characterized using methods described by D'Agostino et al. (1990) (see Appendix B).

^b Statistics were calculated using one half the detection limit for nondetects.

NA Not applicable; value exceeds the maximum detected concentration.

Distributions were "Not Determined" if N < 8 or detection frequency < 50%.

Distributions which were "Not Determined" were assumed to be lognormal.

TABLE 3-55
OPERABLE UNIT 2:
PRELIMINARY CHEMICALS OF INTEREST
IN UPPER SAND AND GRAVEL GROUNDWATER^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Estimated	Detected Range (mg/L)	
	Frequency	Greater Than 50%	Detects ^b	Minimum	Maximum
Benzene	4/48	No	2	1.9E-04	1.9E-03
Bis(2-Ethylhexyl)Phthalate	2/17	No		6.0E-03	1.2E-02
Cadmium	7/31	No		2.0E-06	1.2E-05
Chromium	16/31	Yes		4.8E-05	7.8E-04
Dichloroethane, 1,1-	43/48	Yes		3.8E-03	3.6E+00
Dichloroethane, 1,2-	4/48	No		1.1E-03	4.7E-03
Dichloroethene, 1,1-	28/48	Yes	2	2.3E-03	7.7E-02
Dichloroethene, 1,2-	12/16	Yes		2.0E-03	1.7E-01
Dichloroethene, Cis-1,2-	29/32	Yes	1	8.4E-04	7.5E-01
Dichloroethene, Trans-1,2-	27/32	Yes		7.2E-04	3.8E-02
Methylene Chloride	7/48	No		1.2E-03	2.5E-02
N-Nitrosodiphenylamine	5/17	No		2.0E-03	6.0E-03
Nickel	16/31	Yes	1	4.0E-05	3.4E-02
Tetrachloroethene	2/48	No		4.3E-03	9.0E-03
Trichloroethane, 1,1,1-	11/48	No		1.6E-02	4.3E-01
Trichloroethene	17/48	No		1.0E-03	1.7E+00
Vinyl Chloride	16/46	No	1	3.1E-03	1.1E-01

^a Based on data from the following sample locations:

AF-01S	AF-05S	AF-09S	AF-13S	AF-20S
AF-02S	AF-06S	AF-10S	AF-14S	
AF-03S	AF-07S	AF-11S	AF-15S	
AF-04S	AF-08S	AF-12S	AF-19S	

^b Value represents the number of detected samples which received a verification of "J".

TABLE 3-56
OPERABLE UNIT 2:
COMPARISON OF CONCENTRATIONS OF INORGANIC
PCOIs IN UPPER SAND AND GRAVEL GROUNDWATER TO
BACKGROUND CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/L)^a	UBL (mg/L)^b	Above Background?
Cadmium	1.2E-05	NA	NA
Chromium	7.8E-04	2.2E-01	NO
Nickel	3.4E-02	1.3E-01	NO

a Data from Table 3-55.

b Upper background levels (UBLs) for upper sand and gravel groundwater (see Table 3-8).

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-57
OPERABLE UNIT 2:
COMPARISON OF CONCENTRATIONS OF PCOLs IN UPPER SAND
AND GRAVEL GROUNDWATER TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/L)		Above Benchmark?
	Site Maximum ^a	Benchmark ^b	
Benzene	1.9E-03	5.0E-03	No
Bis(2-Ethylhexyl)Phthalate	1.2E-02	4.8E-03	Yes
Cadmium	1.2E-05	5.0E-03	No
Dichloroethane, 1,1-	3.6E+00	8.1E-01	Yes
Dichloroethane, 1,2-	4.7E-03	5.0E-03	No
Dichloroethene, 1,1-	7.7E-02	7.0E-03	Yes
Dichloroethene, 1,2-	1.7E-01	7.0E-02	Yes
Dichloroethene, Cis-1,2-	7.5E-01	7.0E-02	Yes
Dichloroethene, Trans-1,2-	3.8E-02	1.0E-01	No
Methylene Chloride	2.5E-02	5.0E-03	Yes
N-Nitrosodiphenylamine	6.0E-03	1.4E-02	No
Tetrachloroethene	9.0E-03	5.0E-03	Yes
Trichloroethane, 1,1,1-	4.3E-01	2.0E-01	Yes
Trichloroethene	1.7E+00	5.0E-03	Yes
Vinyl Chloride	1.1E-01	2.0E-03	Yes

^a Data from Table 3-55.

^b See Table 3-11 for source.

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-58
OPERABLE UNIT 2:
PRELIMINARY CHEMICALS OF INTEREST
IN LOWER SAND AND GRAVEL GROUNDWATER^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Estimated	Detected Range (mg/L)	
	Frequency	Greater Than 50%	Detects ^b	Minimum	Maximum
Benzene	7/33	No	1	2.1E-04	6.0E-03
Bis(2-Ethylhexyl)Phthalate	8/13	Yes		2.0E-03	6.6E-02
Bromophenyl Phenyl Ether, 4-	1/13	No		3.0E-03	3.0E-03
Chloromethane	1/30	No		4.1E-02	4.1E-02
Chromium	12/20	Yes	2	1.3E-05	1.9E-01
Dichloroethene, 1,1-	3/33	No		8.2E-03	2.3E-02
Dichloroethene, Cis-1,2-	12/24	Yes	1	2.9E-04	2.6E-01
Nickel	7/20	No	1	5.0E-05	2.1E-01
Tetrachloroethane, 1,1,2,2-	1/34	No		7.0E-03	7.0E-03
Trichloroethene	9/34	No	2	1.4E-03	3.0E-02
Vinyl Chloride	7/32	No	1	7.6E-04	7.0E-03

^a Based on data from the following sample locations:

AF-01D	AF-08D	AF-12D	AF-17D	AF-20D
AF-05D	AF-09D	AF-15D	AF-18D	AF-21D
AF-07D	AF-11D	AF-16D	AF-19D	

^b Value represents the number of detected samples which received a verification of "J".

TABLE 3-59
OPERABLE UNIT 2:
COMPARISON OF CONCENTRATIONS OF INORGANIC PCOIs
IN LOWER SAND AND GRAVEL GROUNDWATER TO
BACKGROUND CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/L)^a	UBL (mg/L)^b	Above Background?
Chromium	1.9E-01	7.1E-02	YES
Nickel	2.1E-01	NA	NA

a Data from Table 3-58.

b Upper background levels (UBLs) for lower sand and gravel groundwater (see Table 3-9).

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-60
OPERABLE UNIT 2:
COMPARISON OF CONCENTRATIONS OF PCOLs IN LOWER SAND
AND GRAVEL GROUNDWATER TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/L)		Above Benchmark?
	Site Maximum ^a	Benchmark ^b	
Benzene	6.0E-03	5.0E-03	Yes
Bis(2-Ethylhexyl)Phthalate	6.6E-02	4.8E-03	Yes
Bromophenyl Phenyl Ether, 4-	3.0E-03	NA	NA
Chloromethane	4.1E-02	1.5E-03	Yes
Chromium	1.9E-01	1.0E-01	Yes
Dichloroethene, 1,1-	2.3E-02	7.0E-03	Yes
Dichloroethene, Cis-1,2-	2.6E-01	7.0E-02	Yes
Nickel	2.1E-01	1.0E-01	Yes
Tetrachloroethane, 1,1,2,2-	7.0E-03	5.5E-05	Yes
Trichloroethene	3.0E-02	5.0E-03	Yes
Vinyl Chloride	7.0E-03	2.0E-03	Yes

a Data from Table 3-58.

b See Table 3-11 for source.

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-61
OPERABLE UNIT 3:
PRELIMINARY CHEMICALS OF INTEREST IN TOTAL SOIL^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Detected Range (mg/kg)	
	Frequency	Greater Than 50%	Minimum	Maximum
Arsenic	26/26	Yes	1.1E+00	1.8E+01
Beryllium	19/26	Yes	7.0E-01	2.7E+00
Lead	26/26	Yes	3.0E+00	6.5E+01
Manganese	26/26	Yes	9.0E+01	2.8E+03
Nickel	25/26	Yes	5.0E+00	1.3E+02
Total Petroleum Hydrocarbons	1/12	No	2.2E+02	2.2E+02

^a Based on data from the following sample locations:

17-SS1	18-SB2C	18-SS4	19-SB4
17-SS2	18-SB3C	18-SS5	19-SS1
17-SS3	18-SB4C	18-SS6	19-SS2
17-SS4	18-SS1	19-SB1	19-SS3
18-MW1S	18-SS2	19-SB2	19-SS4
18-SB1C	18-SS3	19-SB3	

TABLE 3-62
OPERABLE UNIT 3:
COMPARISON OF CONCENTRATIONS OF
INORGANIC PCOIs IN TOTAL SOIL TO
BACKGROUND CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/kg)^a	UBL (mg/kg)^b	Above Background?
Arsenic	1.8E+01	1.1E+01	NO ^c
Beryllium	2.7E+00	2.1E+00	NO ^c
Lead	6.5E+01	3.9E+01	YES
Manganese	2.8E+03	2.0E+03	YES
Nickel	1.3E+02	4.4E+01	YES

a Data from Table 3-61.

b Upper background levels (UBLs) for soil (see Table 3-6).

c Eliminated from further consideration since maximum concentration is within

Ohio farm soil background range (Cox and Colvin, 1996):

arsenic 0.5 to 56 mg/kg

beryllium 0.1 to 3.2 mg/kg.

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-63
OPERABLE UNIT 3:
COMPARISON OF CONCENTRATIONS OF PCOLs IN TOTAL
SOIL TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above PRG?
	Site Maximum^a	PRG^b	
Lead	6.5E+01	1.0E+03	No
Manganese	2.8E+03	4.3E+04	No
Nickel	1.3E+02	3.4E+04	No
Total Petroleum Hydrocarbons	2.2E+02	3.6E+02 ^c	No

^a Data from Table 3-61.

^b Preliminary remediation goals (PRGs) for industrial soil (USEPA, 1996a).

^c Average PRG for total petroleum hydrocarbons (see Section 4.0).

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-64
OPERABLE UNIT 3:
PRELIMINARY CHEMICALS OF INTEREST IN SURFACE SOIL^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Detected Range (mg/kg)	
	Frequency	Greater Than 50%	Minimum	Maximum
Arsenic	14/14	Yes	4.3E+00	1.8E+01
Beryllium	14/14	Yes	7.0E-01	2.7E+00
Lead	14/14	Yes	6.0E+00	6.5E+01
Manganese	14/14	Yes	9.0E+01	9.4E+02
Nickel	14/14	Yes	9.0E+00	1.3E+02
Total Petroleum Hydrocarbons	1/4	No	2.2E+02	2.2E+02

^a Based on data from the following sample locations:

17-SS1	18-SS1	18-SS5	19-SS3
17-SS2	18-SS2	18-SS6	19-SS4
17-SS3	18-SS3	19-SS1	
17-SS4	18-SS4	19-SS2	

TABLE 3-65
OPERABLE UNIT 3:
COMPARISON OF CONCENTRATIONS OF
INORGANIC PCOIs IN SURFACE SOIL TO
BACKGROUND CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/kg)^a	UBL (mg/kg)^b	Above Background?
Arsenic	1.8E+01	1.1E+01	NO ^c
Beryllium	2.7E+00	2.1E+00	NO ^c
Lead	6.5E+01	3.9E+01	YES
Manganese	9.4E+02	2.0E+03	NO
Nickel	1.3E+02	4.4E+01	YES

a Data from Table 3-64.

b Upper background levels (UBLs) for soil (see Table 3-6).

c Eliminated from further consideration since maximum concentration is within

Ohio farm soil background range (Cox and Colvin, 1996):

arsenic 0.5 to 56 mg/kg

beryllium 0.1 to 3.2 mg/kg.

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-66
OPERABLE UNIT 3:
COMPARISON OF CONCENTRATIONS OF PCOIs IN
SURFACE SOIL TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above PRG?
	Site Maximum ^a	PRG ^b	
Lead	6.5E+01	1.0E+03	No
Nickel	1.3E+02	3.4E+04	No
Total Petroleum Hydrocarbons	2.2E+02	3.6E+02 ^c	No

a Data from Table 3-64.

b Preliminary remediation goals (PRGs) for industrial soil (USEPA, 1996a).

c Average PRG for total petroleum hydrocarbons (see Section 4.0).

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-67
OPERABLE UNIT 3:
PRELIMINARY CHEMICALS OF INTEREST
IN TOTAL SOIL (PROTECTION OF GW)^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Detected Range (mg/kg)	
	Frequency	Greater Than 50%	Minimum	Maximum
Aluminum	26/26	Yes	2.2E+03	7.7E+04
Antimony	2/26	No	7.0E+00	1.0E+01
Arsenic	26/26	Yes	1.1E+00	1.8E+01
Cadmium	4/26	No	7.0E-01	1.9E+00
Cobalt	13/26	Yes	6.0E+00	3.7E+01
Copper	26/26	Yes	4.0E+00	1.3E+02
Cyanide	2/20	No	1.6E+00	1.6E+00
Lead	26/26	Yes	3.0E+00	6.5E+01
Mercury	5/26	No	2.0E-01	6.3E+00
Methylene Chloride	4/19	No	5.0E-03	8.0E-03
Nickel	25/26	Yes	5.0E+00	1.3E+02
Toluene	4/18	No	1.0E-02	2.6E-02
Total Petroleum Hydrocarbons	1/12	No	2.2E+02	2.2E+02
Trichloroethane, 1,1,1-	4/18	No	6.0E-03	4.0E-02

^a Based on data from the following sample locations:

17-SS1	18-SB2C	18-SS4	19-SB4
17-SS2	18-SB3C	18-SS5	19-SS1
17-SS3	18-SB4C	18-SS6	19-SS2
17-SS4	18-SS1	19-SB1	19-SS3
18-MW1S	18-SS2	19-SB2	19-SS4
18-SB1C	18-SS3	19-SB3	

TABLE 3-68
OPERABLE UNIT 3:
COMPARISON OF CONCENTRATIONS OF INORGANIC PCOIs
IN TOTAL SOIL (PROTECTION OF GW) TO BACKGROUND
CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/kg)^a	UBL (mg/kg)^b	Above Background?
Aluminum	7.7E+04	2.7E+04	YES
Antimony	1.0E+01	9.5E+00	YES
Arsenic	1.8E+01	1.1E+01	NO^c
Cadmium	1.9E+00	NA	NA
Cobalt	3.7E+01	1.7E+01	YES
Copper	1.3E+02	3.3E+01	YES
Lead	6.5E+01	3.9E+01	YES
Mercury	6.3E+00	NA	NA
Nickel	1.3E+02	4.4E+01	YES

^a Data from Table 3-67.

^b Upper background levels (UBLs) for soil (see Table 3-6).

^c Eliminated from further consideration since maximum concentration is within
Ohio farm soil background range (Cox and Colvin, 1996):
arsenic 0.5 to 56 mg/kg.

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-69
OPERABLE UNIT 3:
COMPARISON OF CONCENTRATIONS OF PCOIs IN
TOTAL SOIL (PROTECTION OF GW) TO HEALTH-BASED
BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above SSL?
	Site Maximum ^a	SSL ^b	
Aluminum	7.7E+04	NA	NA
Antimony	1.0E+01	5.0E+00	Yes
Cadmium	1.9E+00	8.0E+00	No
Cobalt	3.7E+01	NA	NA
Copper	1.3E+02	NA	NA
Cyanide	1.6E+00	4.0E+01	No
Lead	6.5E+01	4.0E+02	No
Mercury	6.3E+00	NA	NA
Methylene Chloride	8.0E-03	2.0E-02	No
Nickel	1.3E+02	1.3E+02	No
Toluene	2.6E-02	1.2E+01	No
Total Petroleum Hydrocarbons	2.2E+02	7.7E+01^c	Yes
Trichloroethane, 1,1,1-	4.0E-02	2.0E+00	No

a Data from Table 3-67.

b Soil screening levels (SSLs) for the protection of groundwater (USEPA, 1996b).

c Average SSL for total petroleum hydrocarbons (see Section 4.0).

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-70
OPERABLE UNIT 3:
PRELIMINARY CHEMICALS OF INTEREST
IN UPPER SAND AND GRAVEL GROUNDWATER^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Detected Range (mg/L)	
	Frequency	Greater Than 50%	Minimum	Maximum
Benzene	1/1	Yes	1.2E-02	1.2E-02
Carbon Disulfide	1/1	Yes	2.2E-02	2.2E-02

^a Based on data from sample location GM-7S.

TABLE 3-71
OPERABLE UNIT 3:
COMPARISON OF CONCENTRATIONS OF PCOLs IN UPPER SAND
AND GRAVEL GROUNDWATER TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/L)		Above Benchmark?
	Site Maximum^a	Benchmark^b	
Benzene	1.2E-02	5.0E-03	Yes
Carbon Disulfide	2.2E-02	2.1E-02	Yes

a Data from Table 3-70.

b See Table 3-11 for source.

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-72
OPERABLE UNIT 4:
PRELIMINARY CHEMICALS OF INTEREST IN TOTAL SOIL^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Estimated Detects ^b	Detected Range (mg/kg)	
	Frequency	Greater Than 50%		Minimum	Maximum
Arsenic	10/11	Yes	4	1.8E+00	2.3E+02
Benzene	1/9	No		1.9E-02	1.9E-02
Beryllium	11/11	Yes		2.5E-01	2.8E+00
Lead	11/11	Yes		6.0E+00	3.5E+03
Manganese	11/11	Yes		6.0E+01	2.5E+03
Nickel	10/11	Yes		1.5E+01	8.8E+02
Trichloroethene	1/9	No		7.3E-02	7.3E-02

a Based on data from the following sample locations:

27_28-MW1S	29-30-SS3
27_28-SB1	29-30-SS4
29-30-SS1	29-SB1
29-30-SS2	31-SB1

b Value represents the number of detected samples which received a verification of "J".

TABLE 3-73
OPERABLE UNIT 4:
COMPARISON OF CONCENTRATIONS OF
INORGANIC PCOIs IN TOTAL SOIL TO
BACKGROUND CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/kg)^a	UBL (mg/kg)^b	Above Background?
Arsenic	2.3E+02	1.1E+01	YES
Beryllium	2.8E+00	2.1E+00	NO^c
Lead	3.5E+03	3.9E+01	YES
Manganese	2.5E+03	2.0E+03	YES
Nickel	8.8E+02	4.4E+01	YES

a Data from Table 3-72.

b Upper background levels (UBLs) for soil (see Table 3-6).

c Eliminated from further consideration since maximum concentration is within
Ohio farm soil background range (Cox and Colvin, 1996):

arsenic 0.5 to 56 mg/kg

beryllium 0.1 to 3.2 mg/kg.

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-74
OPERABLE UNIT 4:
COMPARISON OF CONCENTRATIONS OF PCOLs IN
TOTAL SOIL TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above PRG?
	Site Maximum ^a	PRG ^b	
Arsenic	2.3E+02	2.4E+00	Yes
Benzene	1.9E-02	1.4E+00	No
Lead	3.5E+03	1.0E+03	Yes
Manganese	2.5E+03	4.3E+04	No
Nickel	8.8E+02	3.4E+04	No
Trichloroethene	7.3E-02	7.0E+00	No

a Data from Table 3-72.

b Preliminary remediation goals (PRGs) for industrial soil (USEPA, 1996a).

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-75
OPERABLE UNIT 4:
EXPOSURE POINT CONCENTRATIONS FOR COIs IN TOTAL SOIL
GEAE EVENDALE
(Page 1 of 1)

Chemical	Distribution ^a	Statistics (mg/kg) ^b						Exposure Point Concentrations (mg/kg)	
		Arithmetic Mean	SD	95% UCL Normal	Best Estimate of Mean	95% UCL Lognormal	Maximum Detected	MLE	RME
Arsenic	Lognormal	3.0E+01	6.7E+01	6.6E+01	2.7E+01	2.0E+02	2.3E+02	3.0E+01	2.0E+02
Lead	Lognormal	4.0E+02	1.0E+03	9.7E+02	3.4E+02	NA	3.5E+03	4.0E+02	3.5E+03

^a Distribution characterized using methods described by D'Agostino et al. (1990) (see Appendix B).

^b Statistics were calculated using one half the detection limit for nondetects.

NA Not applicable; value exceeds the maximum detected concentration.

TABLE 3-76
OPERABLE UNIT 4:
PRELIMINARY CHEMICALS OF INTEREST IN SURFACE SOIL^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Estimated Detects ^b	Detected Range (mg/kg)	
	Frequency	Greater Than 50%		Minimum	Maximum
Arsenic	4/4	Yes	4	1.8E+00	2.3E+02
Beryllium	4/4	Yes		2.5E-01	5.6E-01
Lead	4/4	Yes		8.6E+01	3.5E+03
Manganese	4/4	Yes		7.3E+01	2.6E+02
Nickel	4/4	Yes		5.2E+01	8.8E+02

^a Based on data from the following sample locations:

29-30-SS1	29-30-SS3
29-30-SS2	29-30-SS4

^b Value represents the number of detected samples which received a verification of "J".

TABLE 3-77
OPERABLE UNIT 4:
COMPARISON OF CONCENTRATIONS OF INORGANIC
PCOIs IN SURFACE SOIL TO BACKGROUND
CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/kg)^a	UBL (mg/kg)^b	Above Background?
Arsenic^c	2.3E+02	1.1E+01	YES
Beryllium	5.6E-01	2.1E+00	NO
Lead	3.5E+03	3.9E+01	YES
Manganese	2.6E+02	2.0E+03	NO
Nickel	8.8E+02	4.4E+01	YES

a Data from Table 3-76.

b Upper background levels (UBLs) for soil (see Table 3-6).

c Maximum concentration also compared to Ohio farm soil background levels ranging from 0.5 to 56 mg/kg (Cox and Colvin, 1996).

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-78
OPERABLE UNIT 4:
COMPARISON OF CONCENTRATIONS OF PCOIs IN
SURFACE SOIL TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above PRG?
	Site Maximum^a	PRG^b	
Arsenic	2.3E+02	2.4E+00	Yes
Lead	3.5E+03	1.0E+03	Yes
Nickel	8.8E+02	3.4E+04	No

a Data from Table 3-76.

b Preliminary remediation goals (PRGs) for industrial soil (USEPA, 1996a).

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 3-79
OPERABLE UNIT 4:
EXPOSURE POINT CONCENTRATIONS FOR COIs IN SURFACE SOIL
GEAE EVENDALE
(Page 1 of 1)

Chemical	Distribution ^a	Statistics (mg/kg) ^b						Exposure Point Concentrations (mg/kg)	
		Arithmetic Mean	Arithmetic SD	95% UCL Normal	Best Estimate of Mean	95% UCL Lognormal	Maximum Detected	MLE	RME
Arsenic	Not Determined	6.7E+01	1.1E+02	2.0E+02	1.4E+02	NA	2.3E+02	6.7E+01	2.3E+02
Lead	Not Determined	1.0E+03	1.7E+03	3.0E+03	1.3E+03	NA	3.5E+03	1.0E+03	3.5E+03

^a Distribution characterized using methods described by D'Agostino et al. (1990) (see Appendix B).

^b Statistics were calculated using one half the detection limit for nondetects.

NA Not applicable; value exceeds the maximum detected concentration.

Distributions were "Not Determined" if $N < 8$.

Distributions which were "Not Determined" were assumed to be lognormal.

TABLE 3-80
OPERABLE UNIT 4:
PRELIMINARY CHEMICALS OF INTEREST
IN TOTAL SOIL (PROTECTION OF GW)^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Estimated Detects ^b	Detected Range (mg/kg)	
	Frequency	Greater Than 50%		Minimum	Maximum
Aluminum	11/11	Yes		2.5E+03	2.4E+04
Antimony	6/11	Yes	3	1.0E+00	2.6E+01
Arsenic	10/11	Yes		1.8E+00	2.3E+02
Benzene	1/9	No		1.9E-02	1.9E-02
Cadmium	5/11	No		1.0E+00	5.1E+01
Cobalt	7/11	Yes	3	3.5E+00	2.6E+01
Copper	11/11	Yes		8.0E+00	1.6E+03
Cyanide	1/11	No		9.2E-01	9.2E-01
Lead	11/11	Yes		6.0E+00	3.5E+03
Mercury	3/11	No		4.0E-01	1.9E+00
Methyl Ethyl Ketone	2/9	No		1.4E-02	1.8E-02
Methylene Chloride	6/9	Yes		8.0E-03	1.7E-02
Nickel	10/11	Yes		1.5E+01	8.8E+02
Thallium	1/11	No	1	1.1E+00	1.1E+00
Toluene	1/9	No		6.6E-02	6.6E-02
Trichloroethane, 1,1,1-	1/9	No		2.0E-01	2.0E-01
Trichloroethene	1/9	No		7.3E-02	7.3E-02

a Based on data from the following sample locations:

27_28-MW1S	29-30-SS3
27_28-SB1	29-30-SS4
29-30-SS1	29-SB1
29-30-SS2	31-SB1

b Value represents the number of detected samples which received a verification of "J".

TABLE 3-81
OPERABLE UNIT 4:
COMPARISON OF CONCENTRATIONS OF INORGANIC
PCOIs IN TOTAL SOIL (PROTECTION OF GW) TO
BACKGROUND CONCENTRATIONS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Maximum Concentration (mg/kg)^a	UBL (mg/kg)^b	Above Background?
Aluminum	2.4E+04	2.7E+04	NO
Antimony	2.6E+01	9.5E+00	YES
Arsenic ^c	2.3E+02	1.1E+01	YES
Cadmium	5.1E+01	NA	NA
Cobalt	2.6E+01	1.7E+01	YES
Copper	1.6E+03	3.3E+01	YES
Lead	3.5E+03	3.9E+01	YES
Mercury	1.9E+00	NA	NA
Nickel	8.8E+02	4.4E+01	YES
Thallium	1.1E+00	NA	NO

^a Data from Table 3-80.

^b Upper background levels (UBLs) for soil (see Table 3-6).

^c Maximum concentration also compared to Ohio farm soil background levels ranging from 0.5 to 56 mg/kg (Cox and Colvin, 1996).

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above background.

TABLE 3-82
OPERABLE UNIT 4:
COMPARISON OF CONCENTRATIONS OF PCOIs IN
TOTAL SOIL (PROTECTION OF GW) TO HEALTH-
BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above SSL?
	Site Maximum^a	SSL^b	
Antimony	2.6E+01	5.0E+00	Yes
Arsenic	2.3E+02	2.9E+01	Yes
Benzene	1.9E-02	3.0E-02	No
Cobalt	2.6E+01	NA	NA
Copper	1.6E+03	NA	NA
Cyanide	9.2E-01	4.0E+01	No
Lead	3.5E+03	4.0E+02	Yes
Mercury	1.9E+00	NA	NA
Methyl Ethyl Ketone	1.8E-02	NA	NA
Methylene Chloride	1.7E-02	2.0E-02	No
Nickel	8.8E+02	1.3E+02	Yes
Toluene	6.6E-02	1.2E+01	No
Trichloroethane, 1,1,1-	2.0E-01	2.0E+00	No
Trichloroethene	7.3E-02	6.0E-02	Yes

^a Data from Table 3-80.

^b Soil screening levels (SSLs) for the protection of groundwater (USEPA, 1996b).

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above benchmark.

TABLE 3-83
OPERABLE UNIT 4:
PRELIMINARY CHEMICALS OF INTEREST
IN LOWER SAND AND GRAVEL GROUNDWATER^a
GEAE EVENDALE
(Page 1 of 1)

Chemical	Detection	Detection Frequency	Detected Range (mg/L)	
	Frequency	Greater Than 50%	Minimum	Maximum
Benzene	2/3	Yes	3.3E-02	1.8E-01

a Based on data from the following sample locations:

27_28-MW-1D
27_28-MW-2D
27_28-MW-5D

TABLE 3-84
OPERABLE UNIT 4:
COMPARISON OF CONCENTRATIONS OF PCOLs IN
LOWER SAND AND GRAVEL GROUNDWATER TO
HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/L)		Above Benchmark?
	Site Maximum^a	Benchmark^b	
Benzene	1.8E-01	5.0E-03	Yes

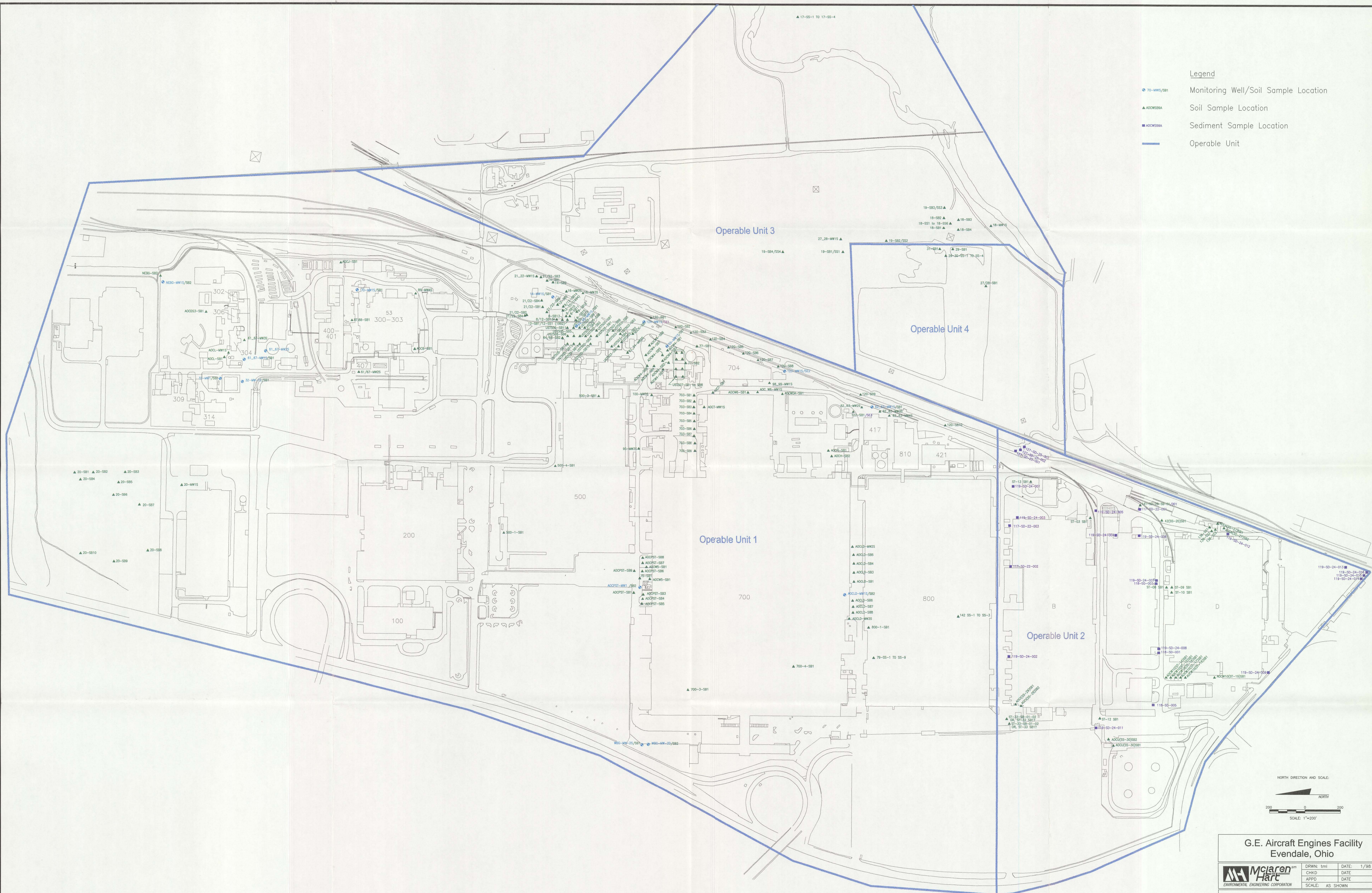
^a Data from Table 3-83.

^b See Table 3-11 for source.

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

Legend

- 70-MW15/SB1 Monitoring Well/Soil Sample Location
- ▲ AOCW58A Soil Sample Location
- AOCW58A Sediment Sample Location
- Operable Unit



Note:
Base map prepared by O'Brien & Gere Engineers, Inc.
(H) Division 75 Evendale RFI-RPT (9F-22 SF=2400)
File Number: 4803.009-09F

DRAFT

DRAFT

G.E. Aircraft Engines Facility Evendale, Ohio	
McClaren Hart ENVIRONMENTAL ENGINEERING CORPORATION	DRWN: tml CHKD: [blank] APPD: [blank] SCALE: AS SHOWN
RFI Soil and Sediment Sample Locations	
Filename: r:\3673\3673soil.dwg Plot File: r:\3673\3673gwat.pc2	DRAWING NUMBER FIG. 3-1

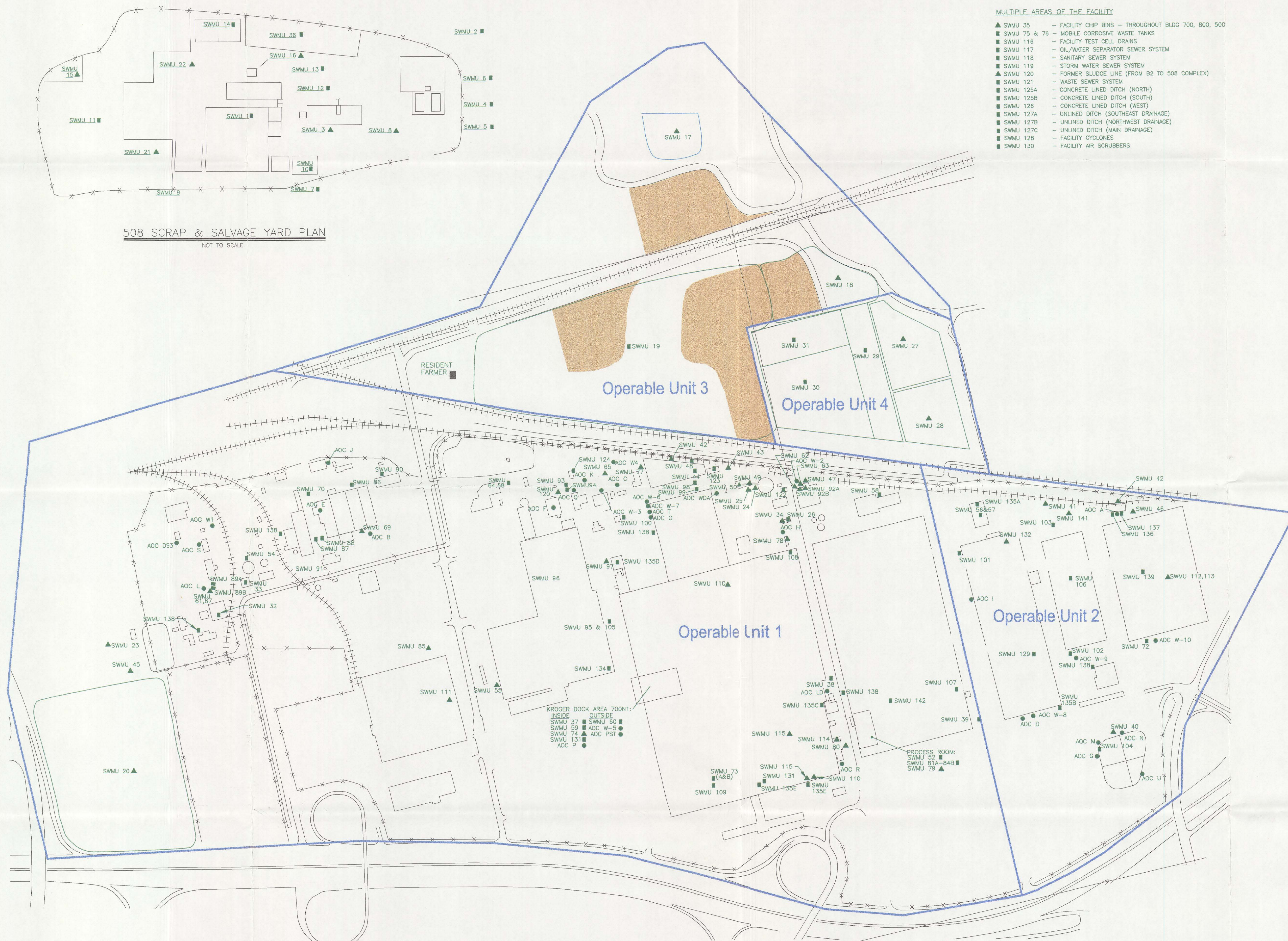


FIGURE 3-3
OPERABLE UNIT 1:
IDENTIFICATION OF COIs IN TOTAL SOIL
GEAE EVENDALE

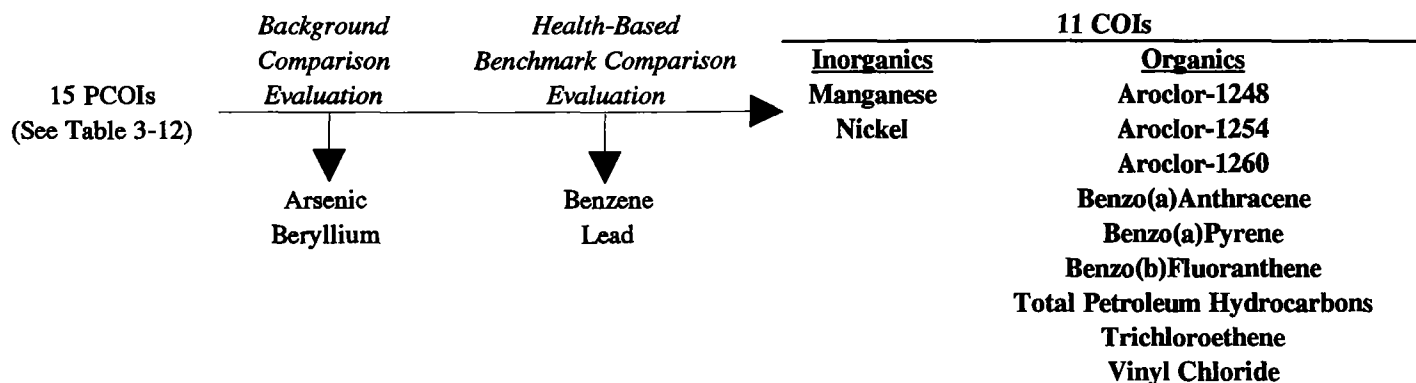


FIGURE 3-4
OPERABLE UNIT 1:
CONCENTRATIONS OF ARSENIC IN TOTAL SOIL
GEAE EVENDALE

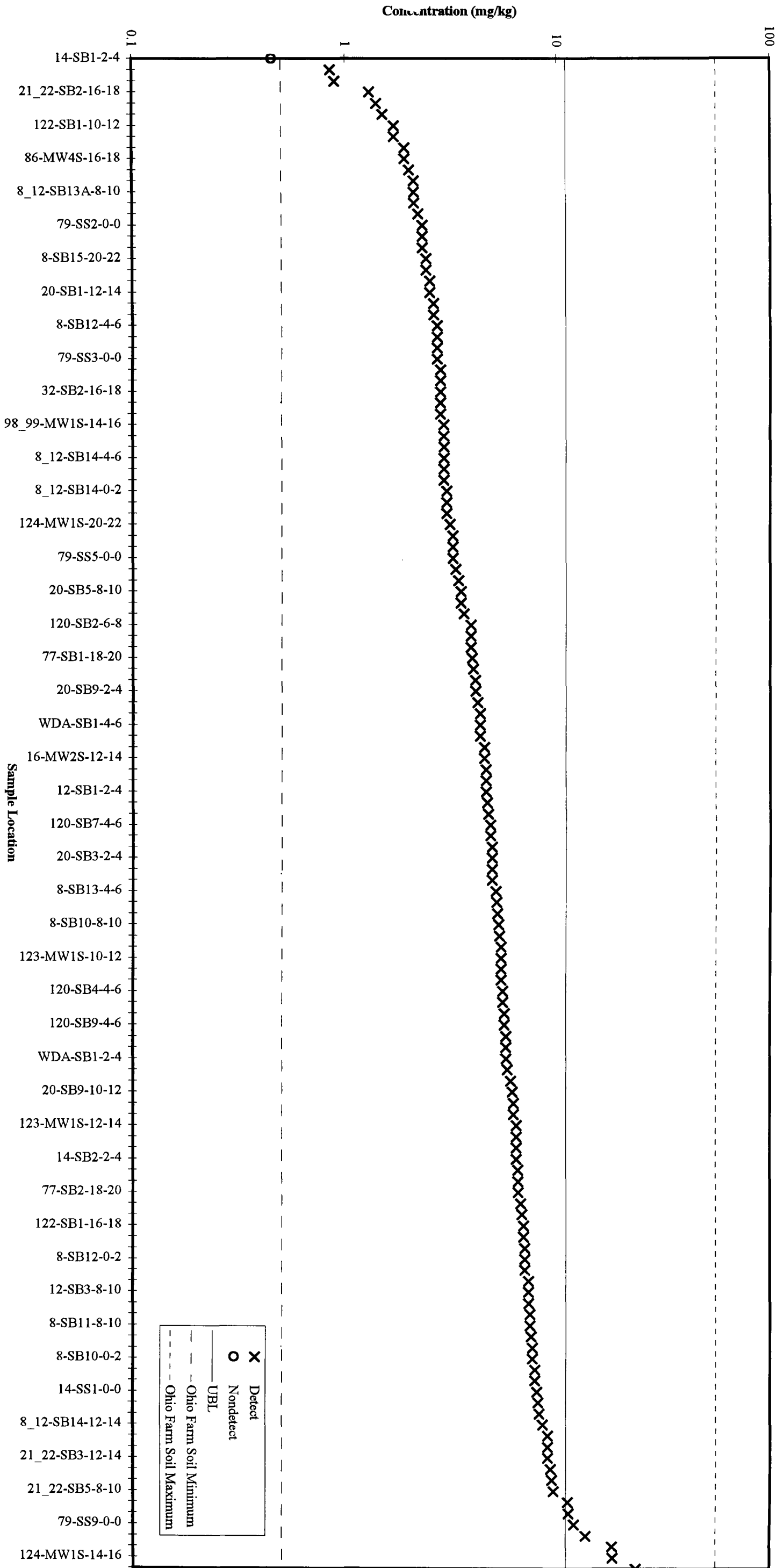


FIGURE 3-5
OPERABLE UNIT 1:
CONCENTRATIONS OF BERYLLIUM IN TOTAL SOIL
GEAE EVENDALE

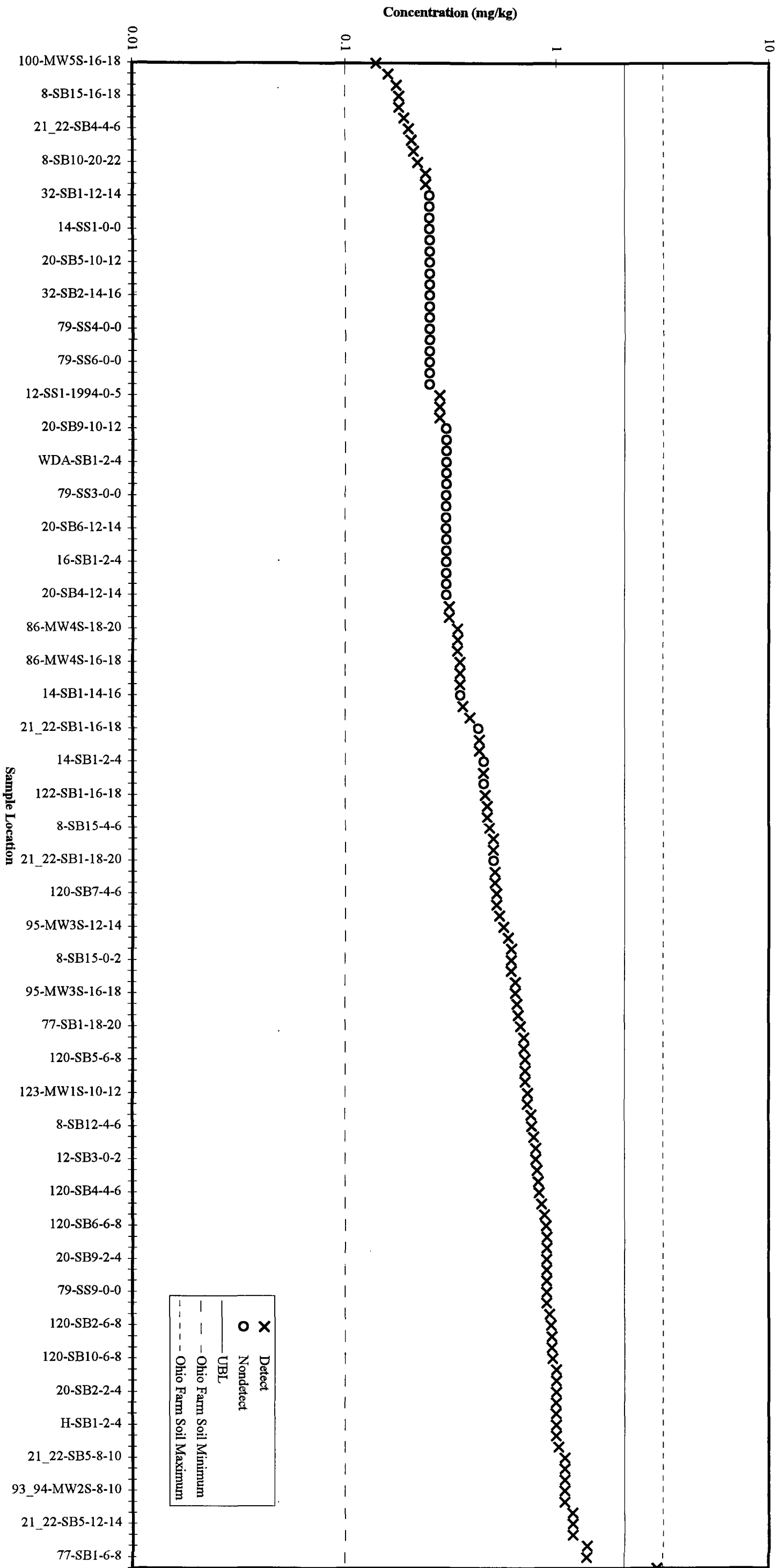
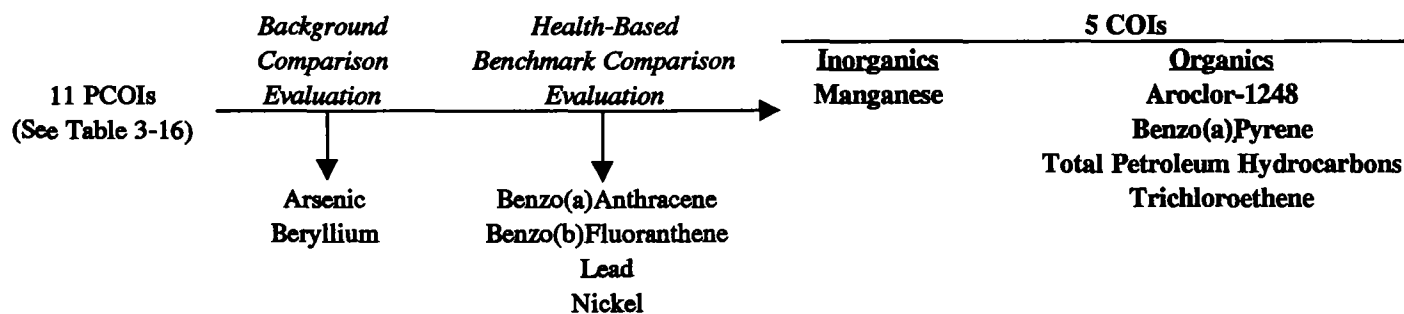


FIGURE 3-6
OPERABLE UNIT 1:
IDENTIFICATION OF COIs IN SURFACE SOIL
GEAE EVENDALE



**FIGURE 3-7
OPERABLE UNIT 1:
CONCENTRATIONS OF ARSENIC IN SURFACE SOIL
GEAE EVENDALE**

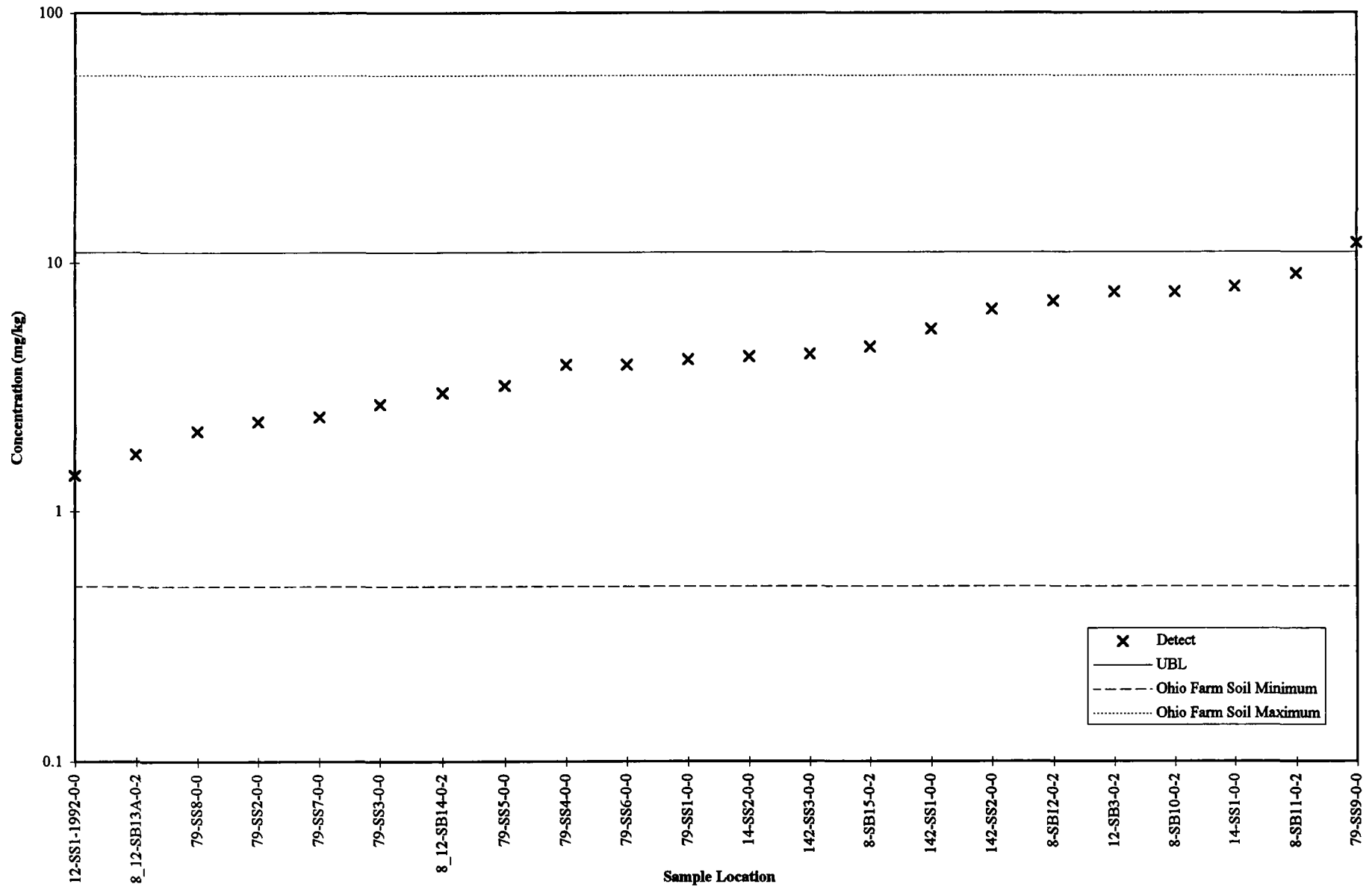


FIGURE 3-8
OPERABLE UNIT 1:
IDENTIFICATION OF COIs IN SEDIMENT
GEAE EVENDALE

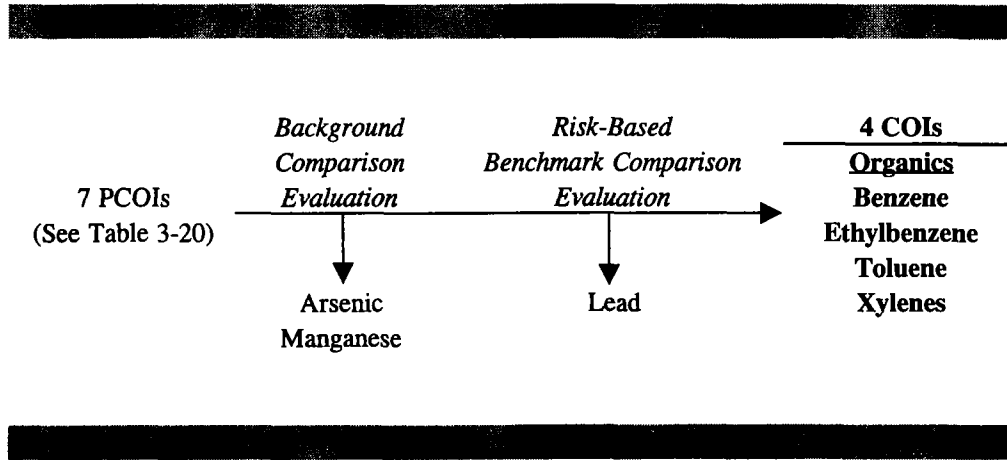


FIGURE 3-9
OPERABLE UNIT 1:
IDENTIFICATION OF COIs IN TOTAL SOIL (PROTECTION OF GW)
GEAE EVENDALE

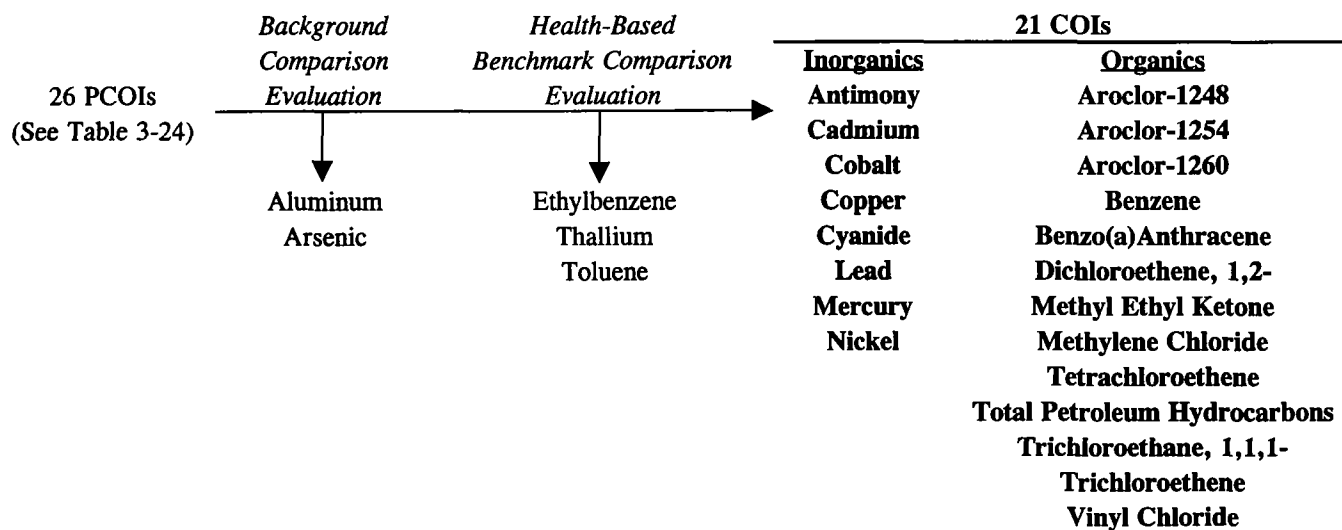


FIGURE 3-10
OPERABLE UNIT 1:
IDENTIFICATION OF COIs IN PERCHED GROUNDWATER
GEAE EVENDALE

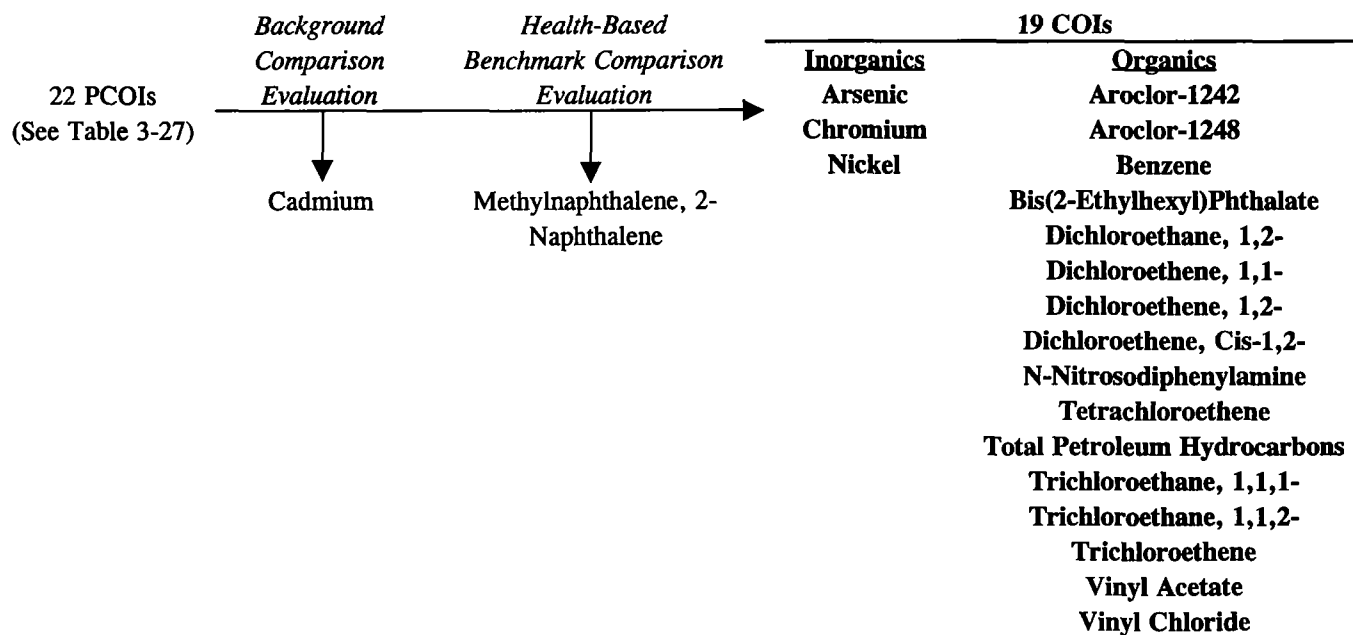
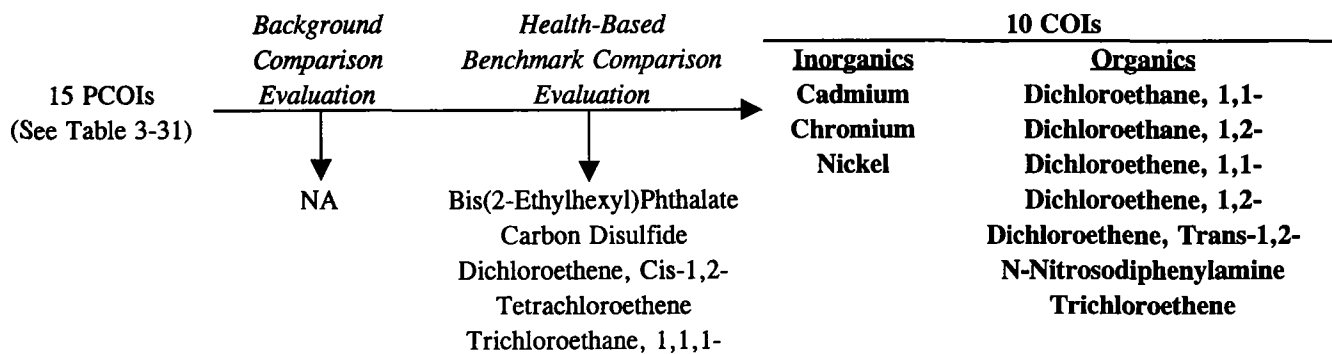
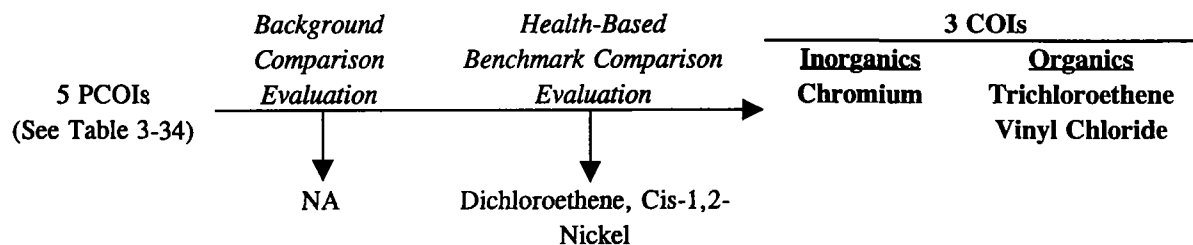


FIGURE 3-11
OPERABLE UNIT 1:
IDENTIFICATION OF COIs IN UPPER SAND AND GRAVEL GROUNDWATER
GEAE EVENDALE



NA Not applicable.

FIGURE 3-12
OPERABLE UNIT 1:
IDENTIFICATION OF COIs IN
LOWER SAND AND GRAVEL GROUNDWATER
GEAE EVENDALE



NA Not Applicable.

FIGURE 3-13
OPERABLE UNIT 2:
IDENTIFICATION OF COIs IN TOTAL SOIL
GEAE EVENDALE

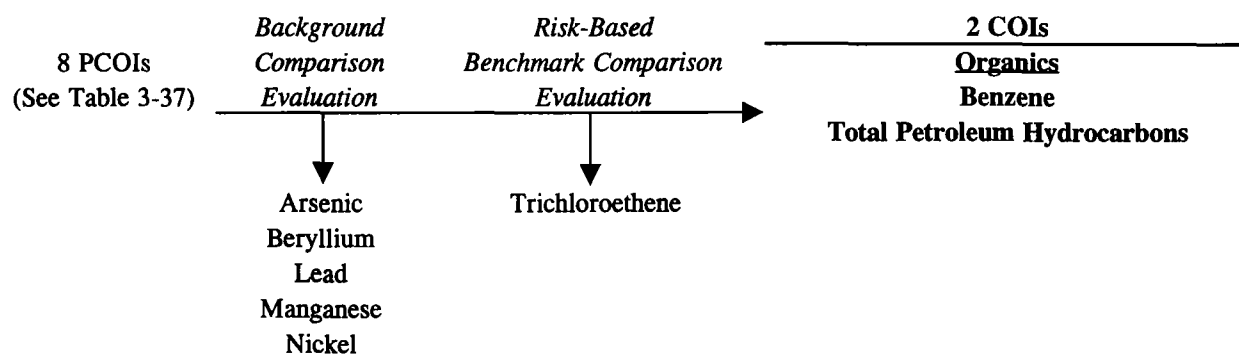
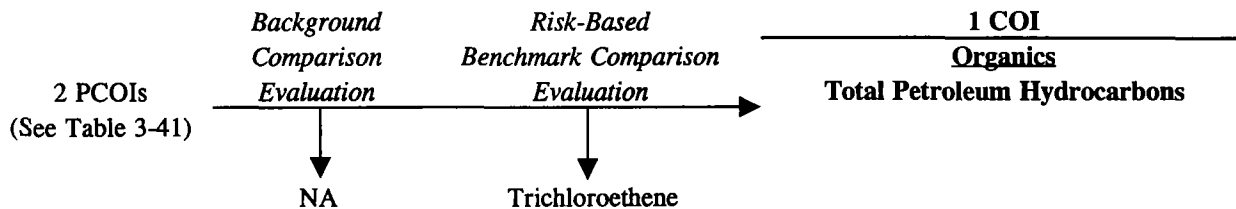


FIGURE 3-14
OPERABLE UNIT 2:
IDENTIFICATION OF COIs IN SURFACE SOIL
GEAE EVENDALE



NA Not Applicable.

FIGURE 3-15
OPERABLE UNIT 2:
IDENTIFICATION OF COIs IN SEDIMENT
GEAE EVENDALE

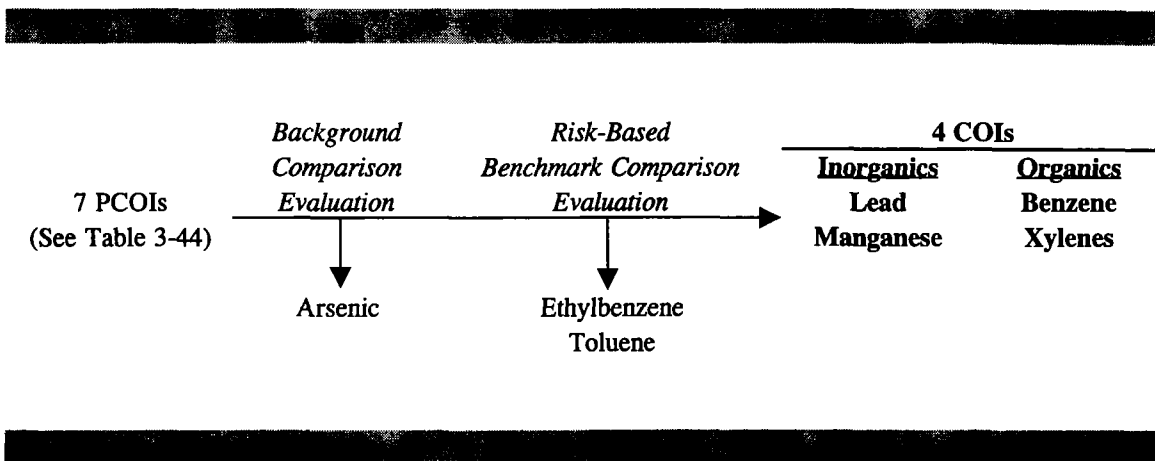


FIGURE 3-16
OPERABLE UNIT 2:
CONCENTRATIONS OF ARSENIC IN SEDIMENT
GEAE EVENDALE

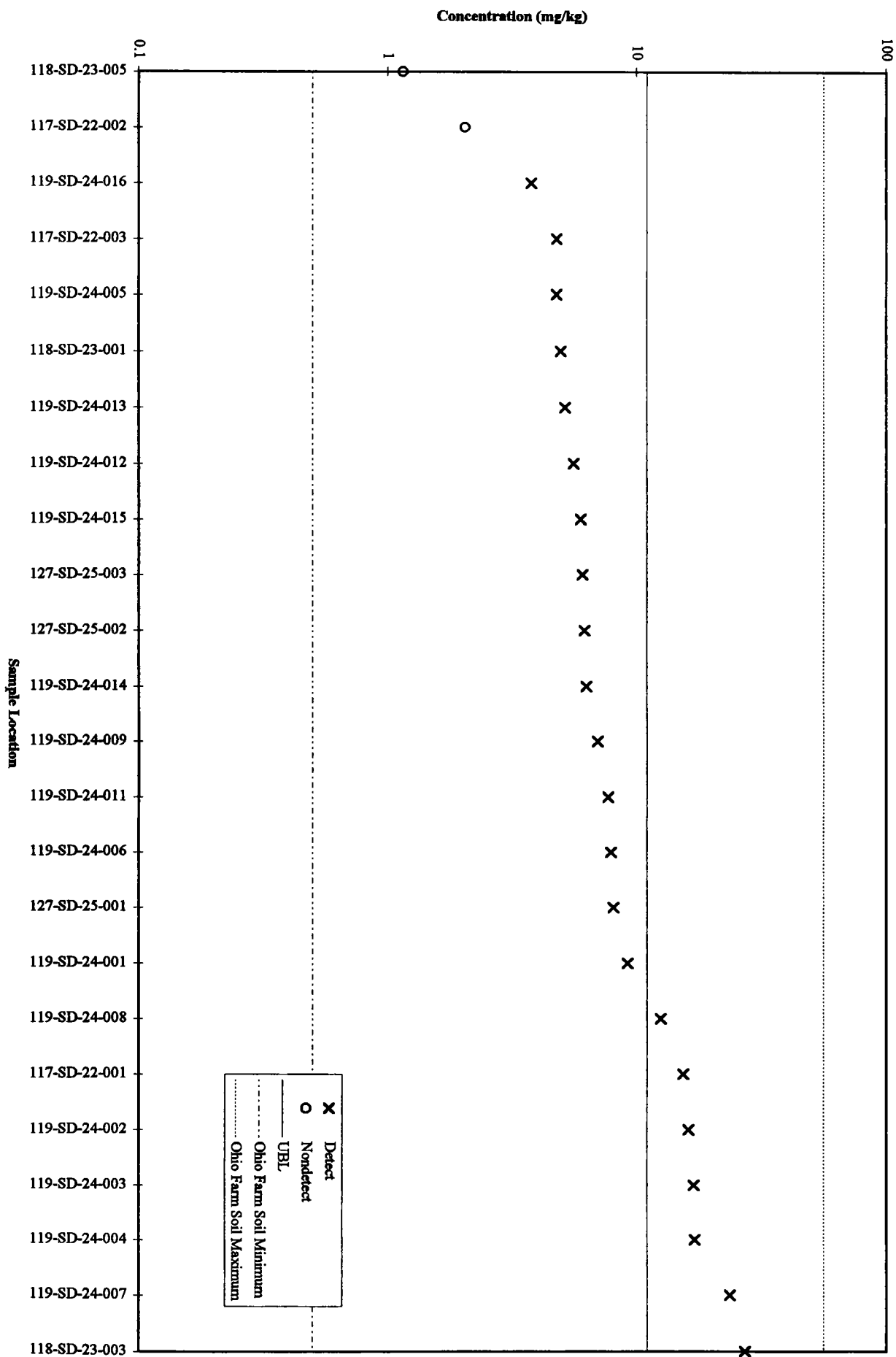


FIGURE 3-17
OPERABLE UNIT 2:
IDENTIFICATION OF COIs IN TOTAL SOIL (PROTECTION OF GW)
GEAE EVENDALE

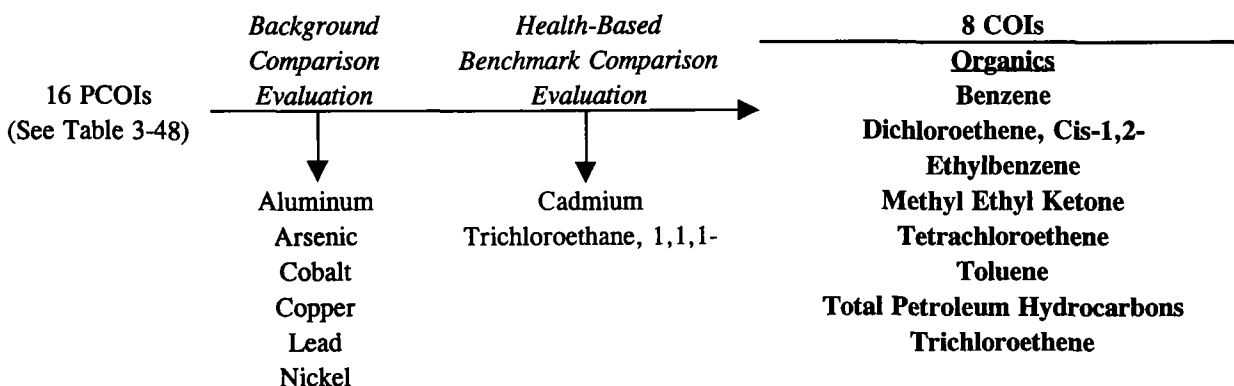
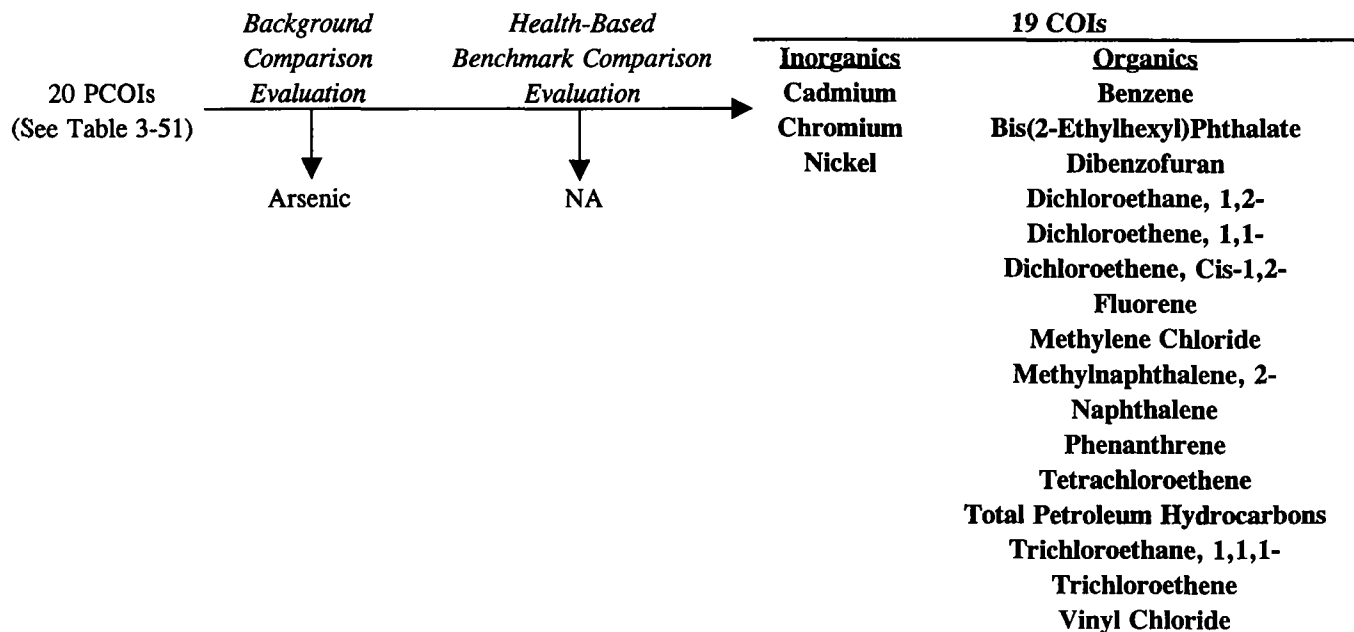


FIGURE 3-18
OPERABLE UNIT 2:
IDENTIFICATION OF COIs IN PERCHED GROUNDWATER
GEAE EVENDALE



NA Not Applicable.

FIGURE 3-19
OPERABLE UNIT 2:
IDENTIFICATION OF COIs IN UPPER SAND AND GRAVEL GROUNDWATER
GEAE EVENDALE

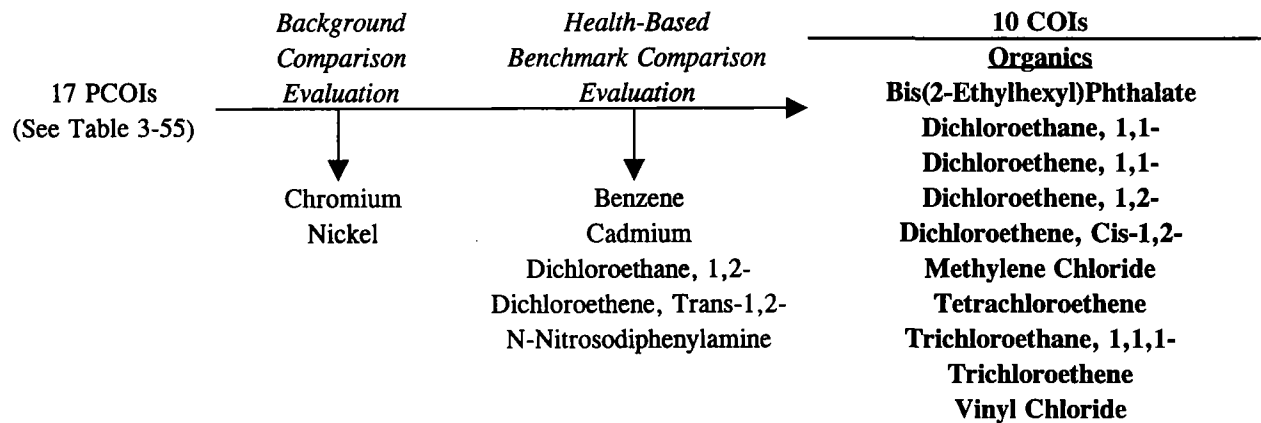
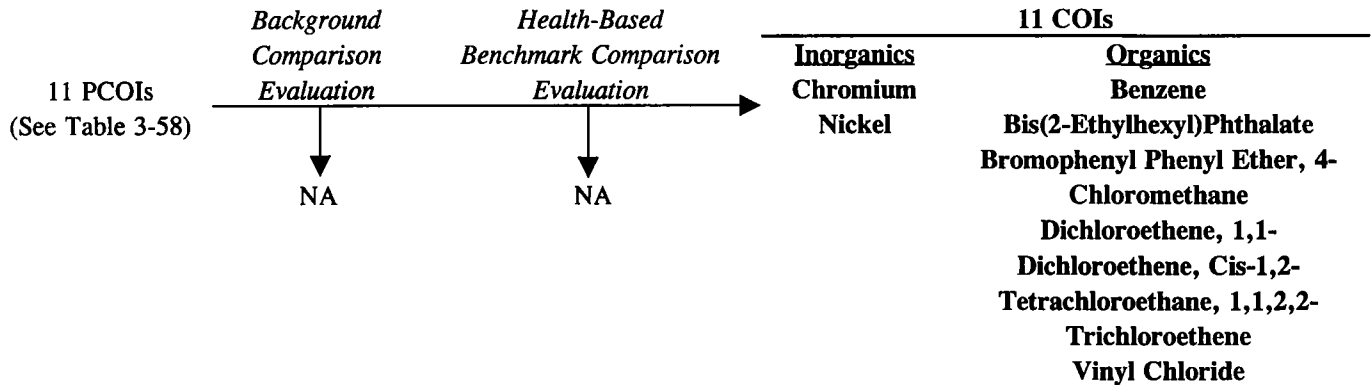


FIGURE 3-20
OPERABLE UNIT 2:
IDENTIFICATION OF COIs IN LOWER SAND AND GRAVEL GROUNDWATER
GEAE EVENDALE



NA Not Applicable.

FIGURE 3-21
OPERABLE UNIT 3:
IDENTIFICATION OF COIs IN TOTAL SOIL
GEAE EVENDALE

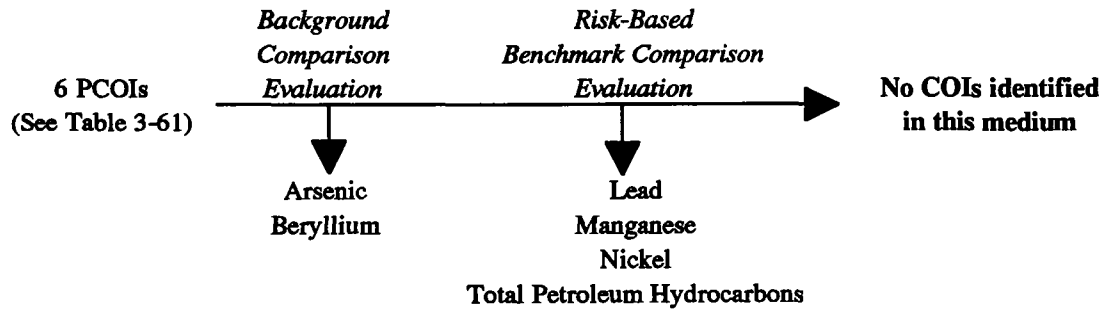


FIGURE 3-22
OPERABLE UNIT 3:
CONCENTRATIONS OF ARSENIC IN TOTAL SOIL
GEAE EVENDALE

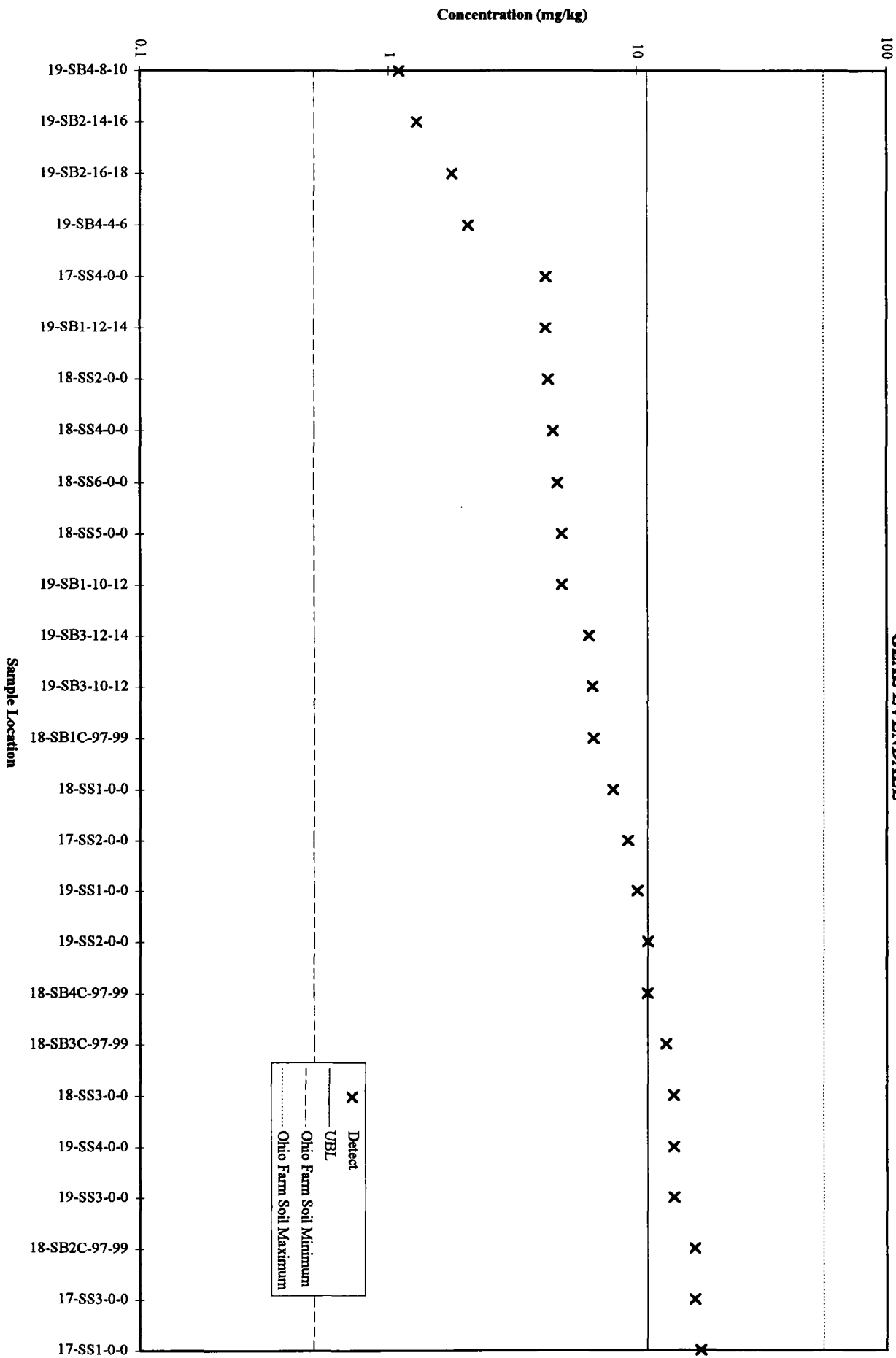


FIGURE 3-23
OPERABLE UNIT 3:
CONCENTRATIONS OF BERYLLIUM IN TOTAL SOIL
GEAE EVENDALE

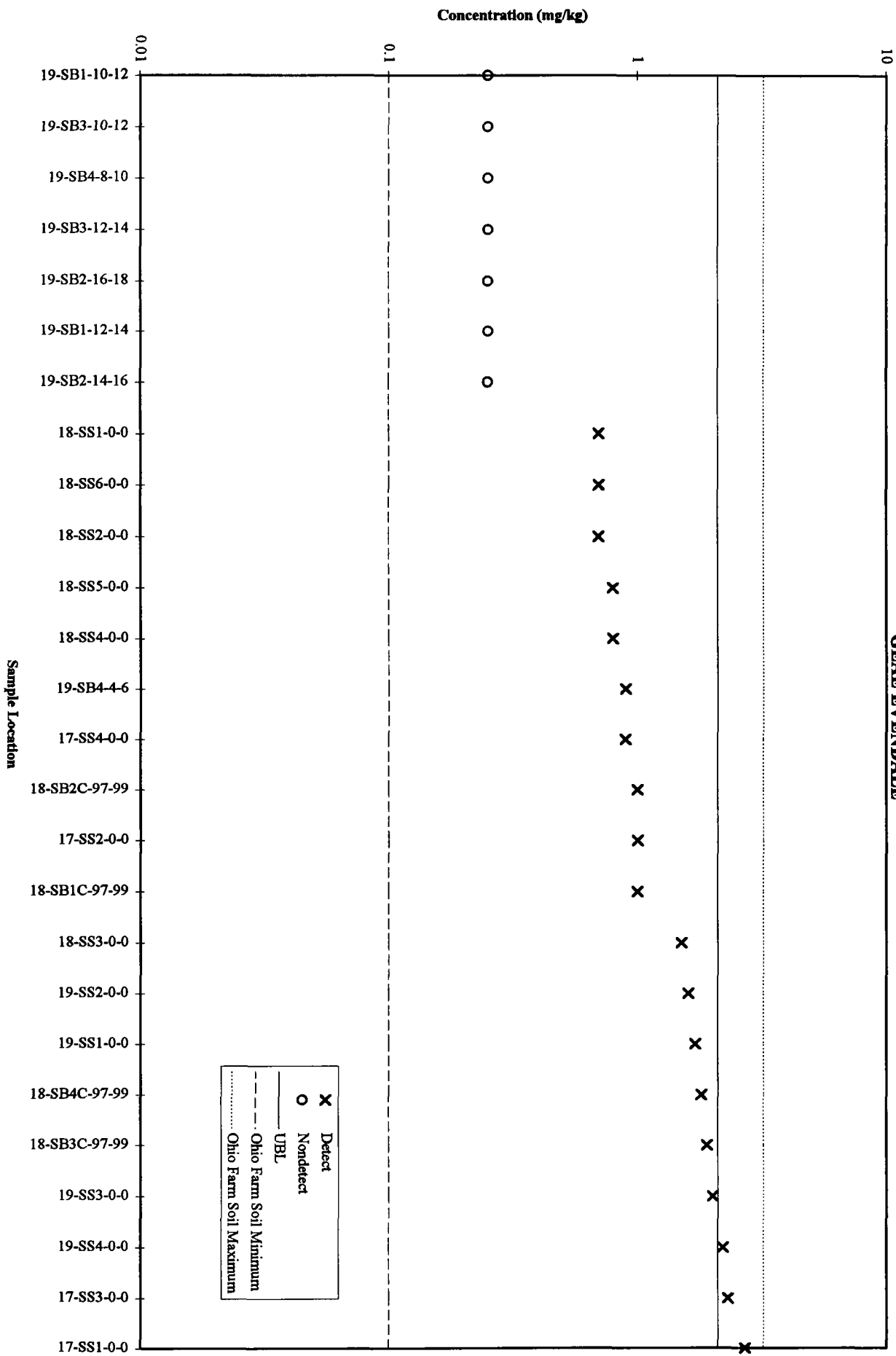


FIGURE 3-24
OPERABLE UNIT 3:
IDENTIFICATION OF COIs IN SURFACE SOIL
GEAE EVENDALE

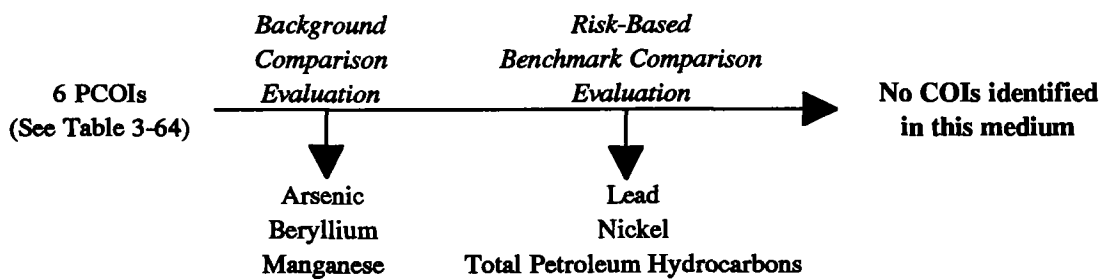


FIGURE 3-25
OPERABLE UNIT 3:
CONCENTRATIONS OF ARSENIC IN SURFACE SOIL
GEAE EVENDALE

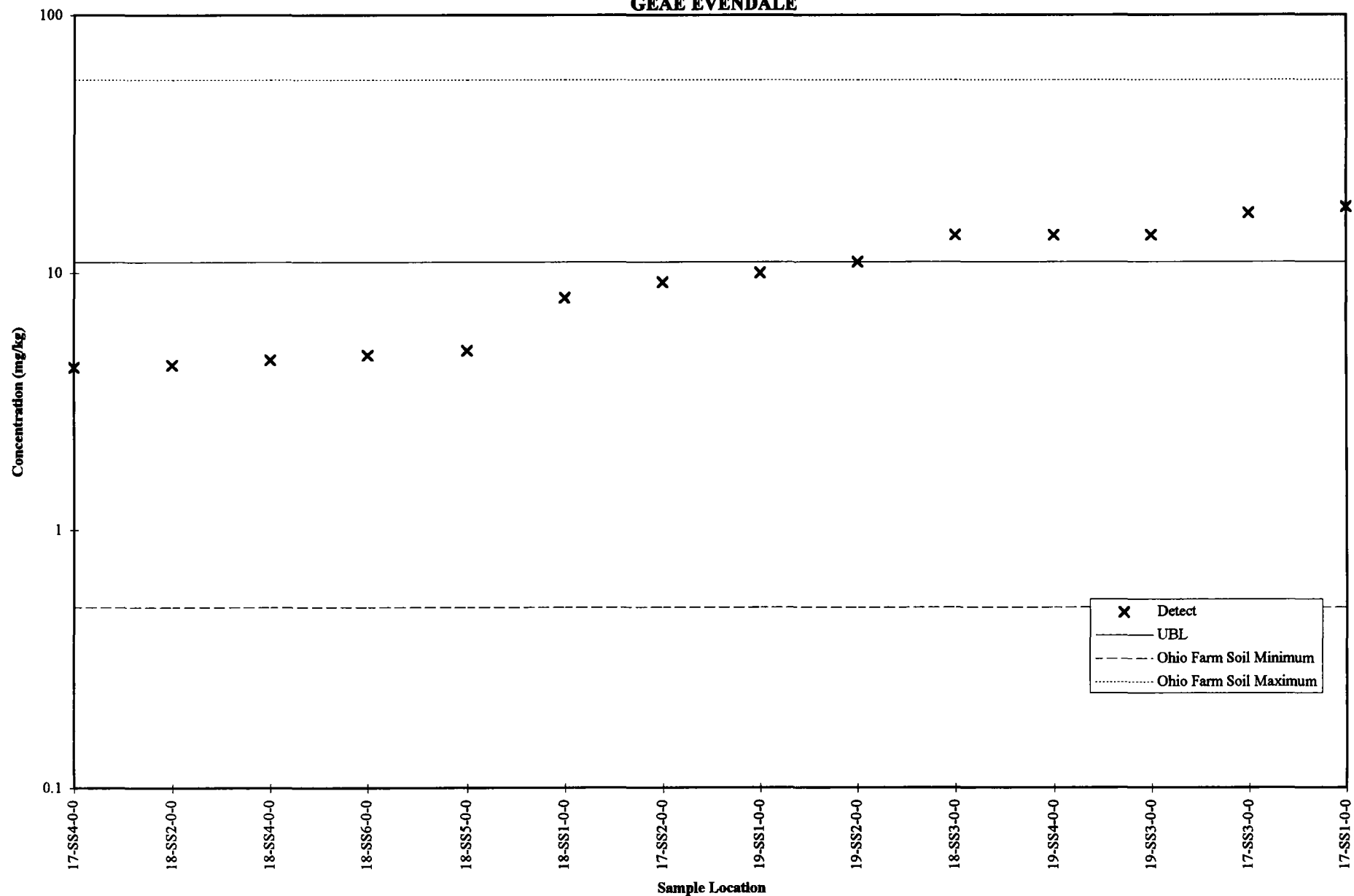


FIGURE 3-26
OPERABLE UNIT 3:
CONCENTRATIONS OF BERYLLIUM IN SURFACE SOIL
GEAE EVENDALE

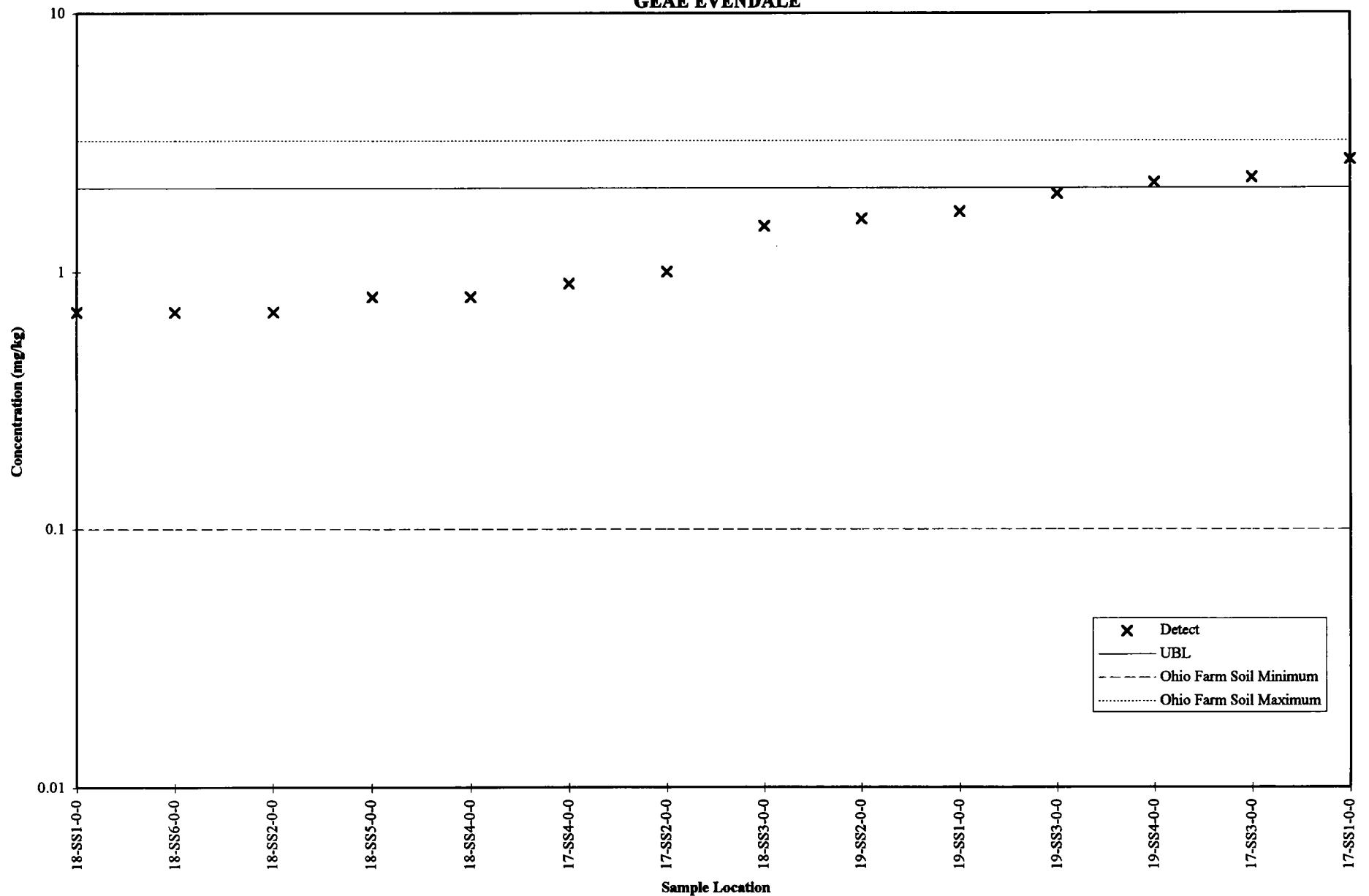


FIGURE 3-27
OPERABLE UNIT 3:
IDENTIFICATION OF COIs IN TOTAL SOIL (PROTECTION OF GW)
GEAE EVENDALE

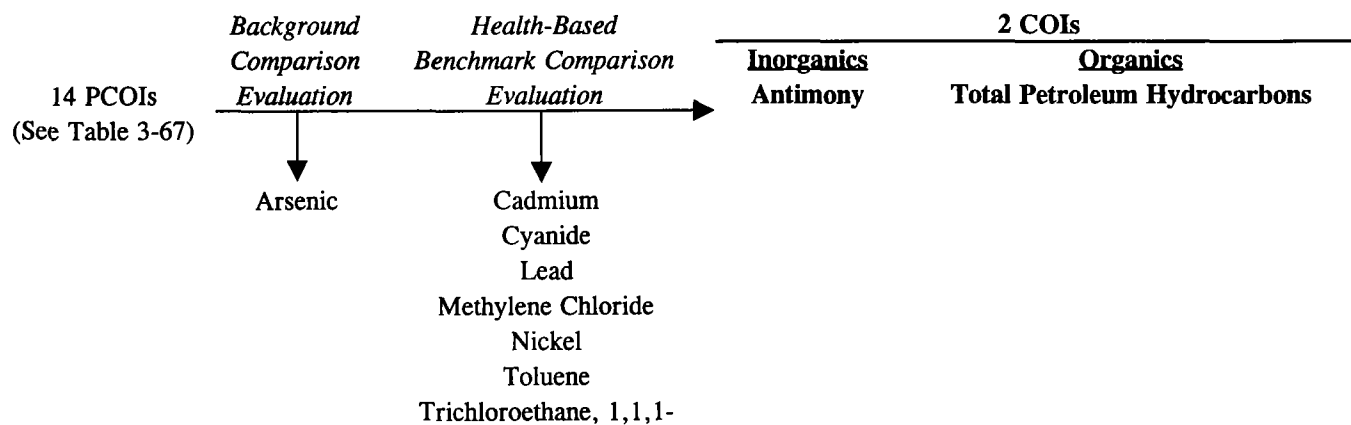
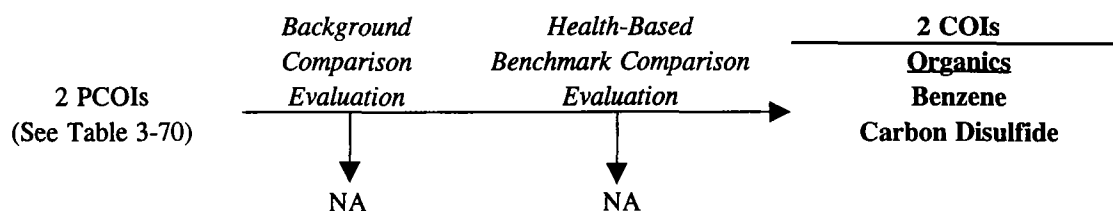
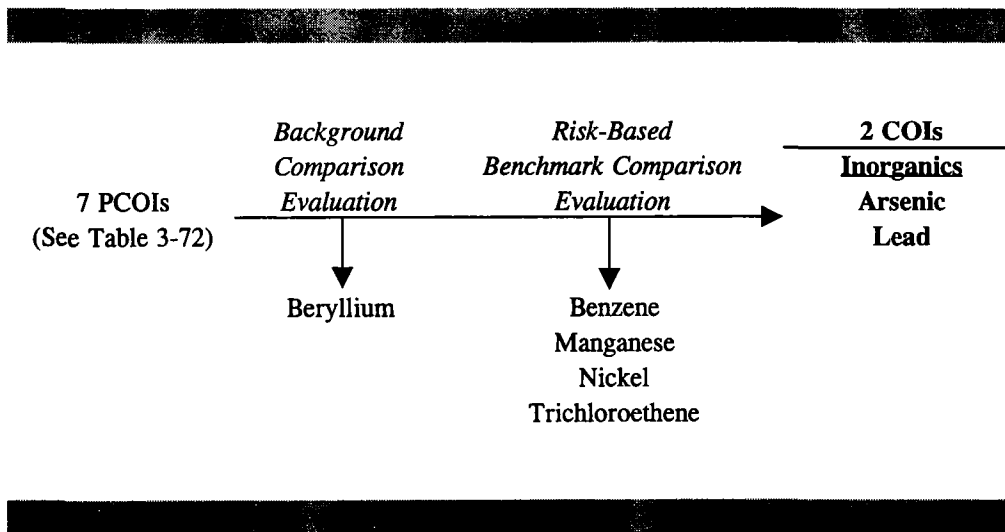


FIGURE 3-28
OPERABLE UNIT 3:
IDENTIFICATION OF COIs IN UPPER SAND AND GRAVEL GROUNDWATER
GEAE EVENDALE

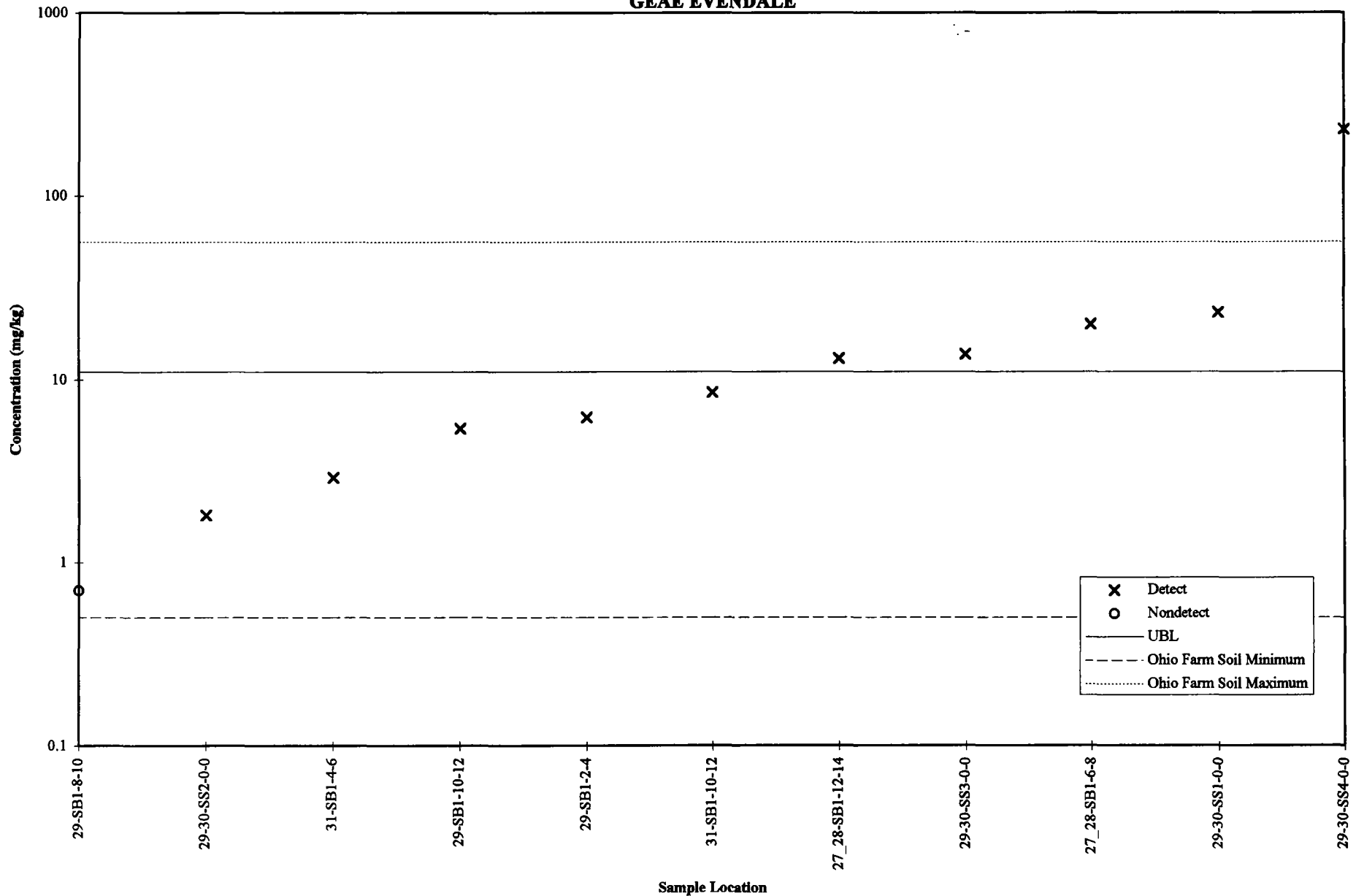


NA Not Applicable.

FIGURE 3-29
OPERABLE UNIT 4:
IDENTIFICATION OF COIs IN TOTAL SOIL
GEAE EVENDALE



**FIGURE 3-30
OPERABLE UNIT 4:
CONCENTRATIONS OF ARSENIC IN TOTAL SOIL
GEAE EVENDALE**



**FIGURE 3-31
OPERABLE UNIT 4:
CONCENTRATIONS OF BERYLLIUM IN TOTAL SOIL
GEAE EVENDALE**

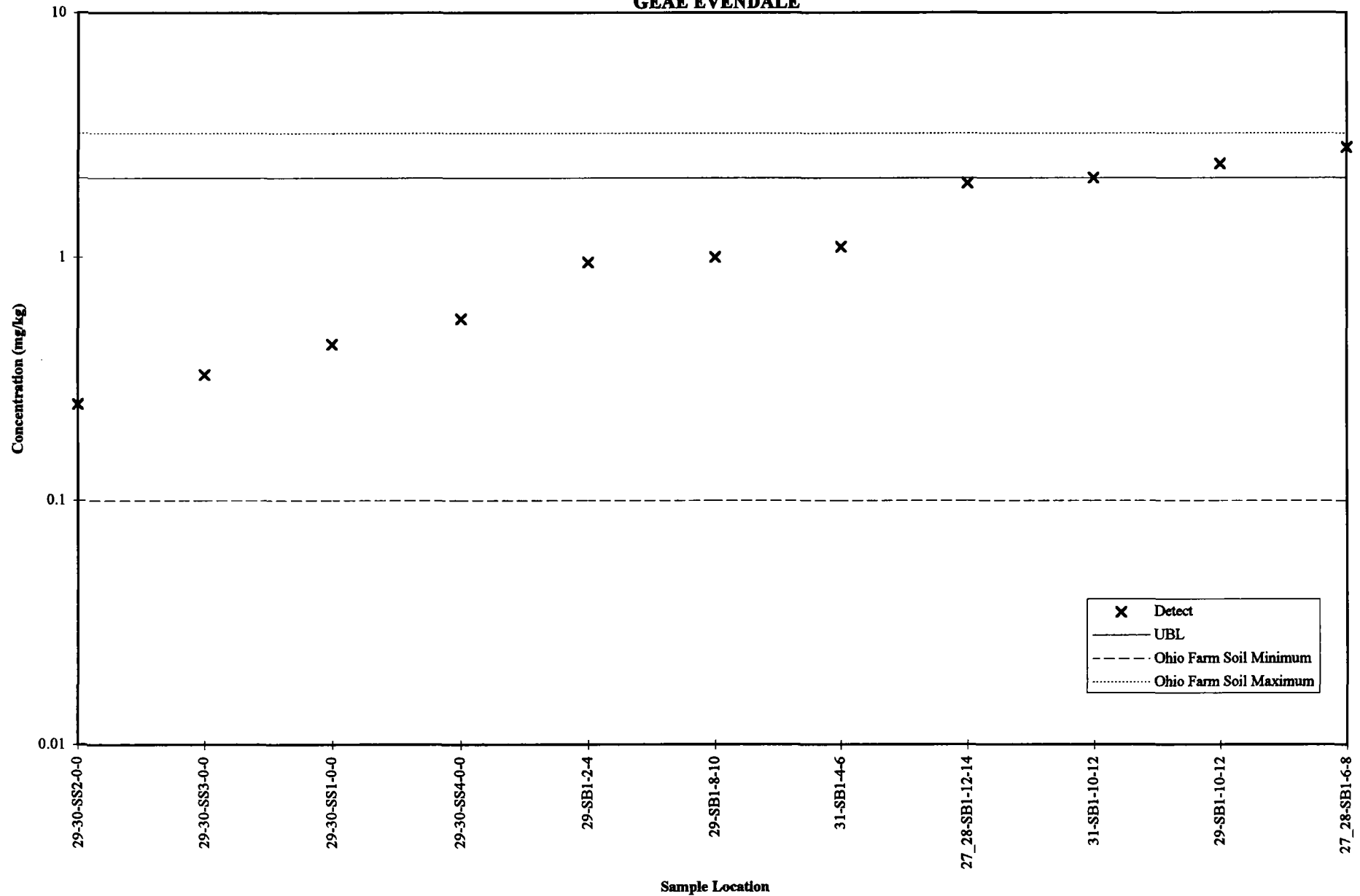


FIGURE 3-32
OPERABLE UNIT 4:
IDENTIFICATION OF COIs IN SURFACE SOIL
GEAE EVENDALE

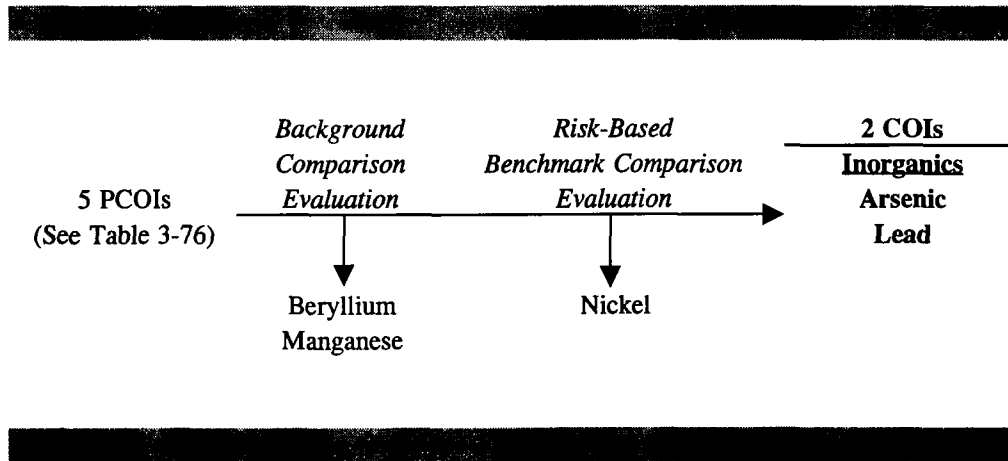


FIGURE 3-33
OPERABLE UNIT 4:
CONCENTRATIONS OF ARSENIC IN SURFACE SOIL
GEAE EVENDALE

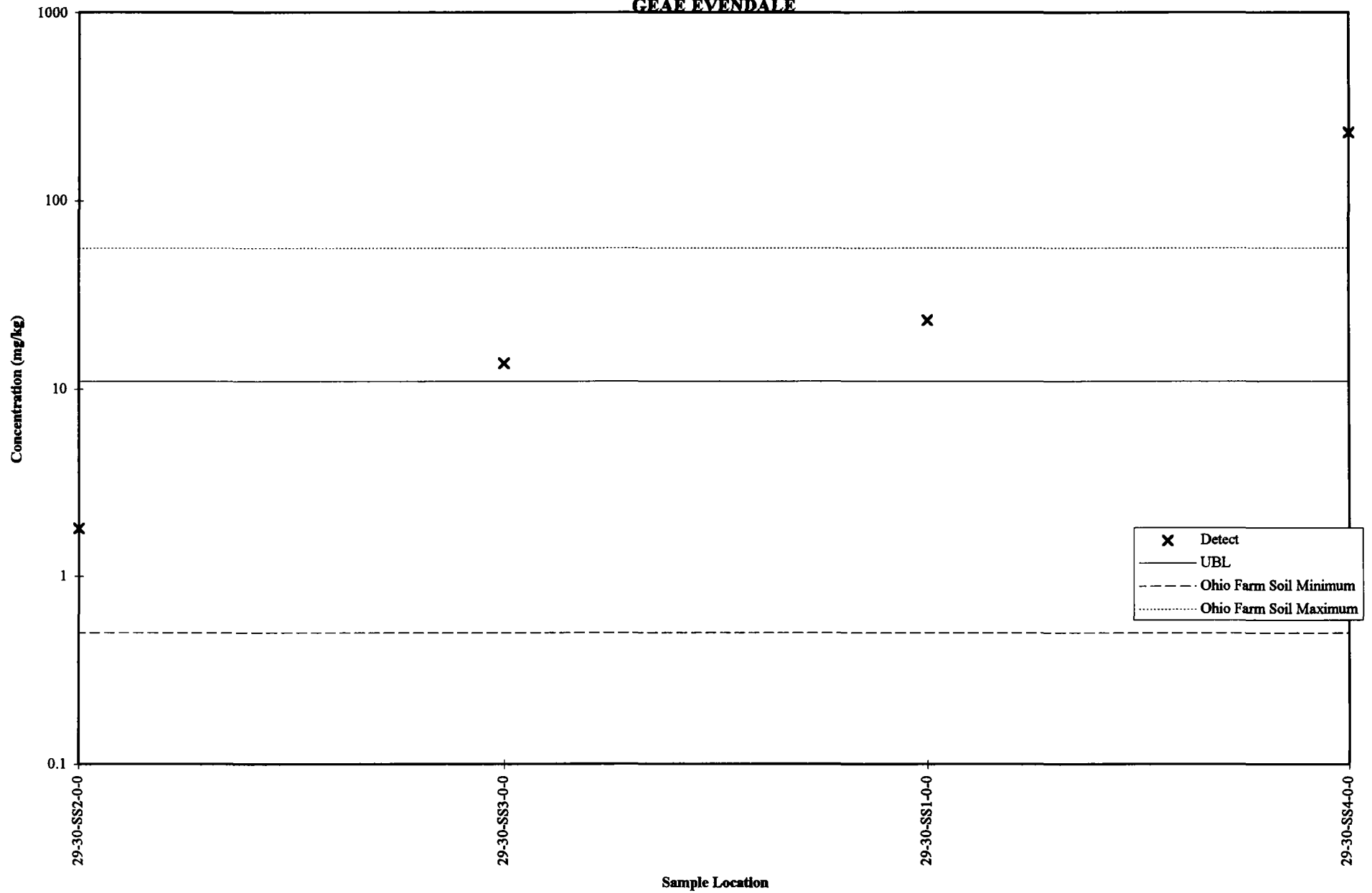


FIGURE 3-34
OPERABLE UNIT 4:
IDENTIFICATION OF COIs IN TOTAL SOIL (PROTECTION OF GW)
GEAE EVENDALE

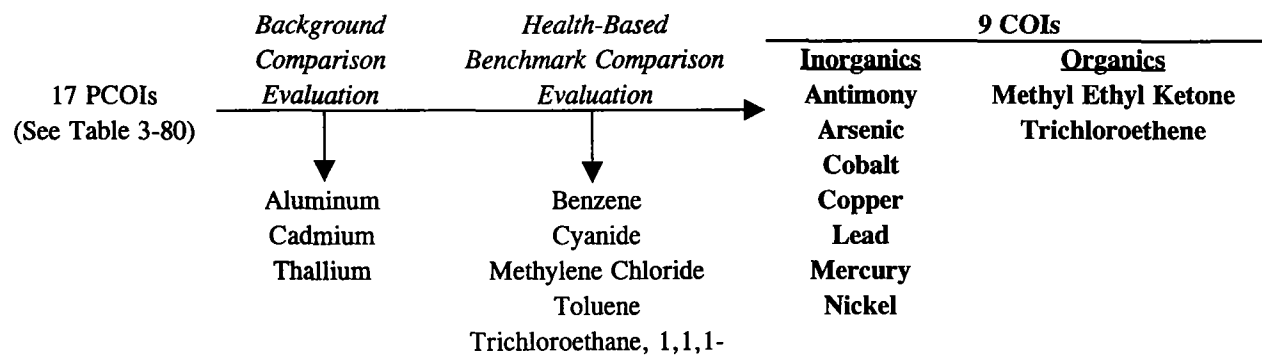
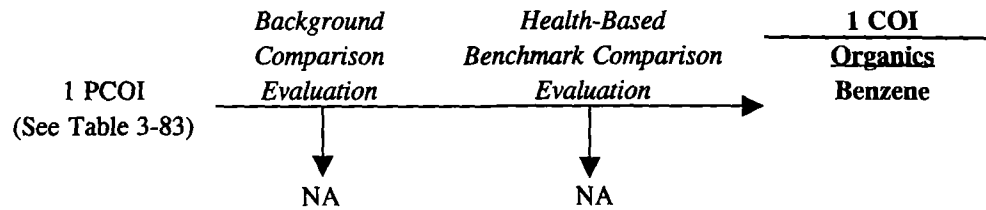


FIGURE 3-35
OPERABLE UNIT 4:
IDENTIFICATION OF COIs IN
LOWER SAND AND GRAVEL GROUNDWATER
GEAE EVENDALE



NA Not Applicable.

4.0 TOXICITY ASSESSMENT

This section presents the chemical specific dose-response information used in the risk assessment.

4.1 Dose-Response Information Sources

As defined in the approved risk assessment work plan, toxicity values used for risk assessment were obtained according to the following hierarchy of sources:

- (1) *Integrated Risk Information System (IRIS, 1997)*
- (2) *Health Effects Assessment Summary Tables (HEAST, 1995)*
- (3) *Provisional Values*
- (4) *Surrogate Values*

Toxicity values identified from these sources are discussed below according to endpoint (noncarcinogenic or carcinogenic health effects), and route of exposure (oral, inhalation, or dermal).

4.2 Noncarcinogenic Health Effects

Oral

Subchronic and chronic oral reference doses (RfDs) and the USEPA's confidence level in the chronic value are presented in Table 4-1 for chemicals identified as PCOIs. In addition, the test species, critical effect, exposure media used in the key study, and source of the RfD are identified. Some chemicals have more than one entry in the table; for example, two RfDs have been developed by USEPA for cadmium (in food and water). The majority of the chemicals (50%) have RfDs available from IRIS (1997) or HEAST (1995); however, a number of chemicals are represented by provisional RfDs or surrogate RfDs. Surrogate RfDs are developed assuming equal potency between the chemical and the surrogate chemical.

Inhalation

Subchronic and chronic inhalation reference concentrations (RfCs) and RfDs and the USEPA's confidence in the chronic value are shown in Table 4-2. The test species, critical effect from the key study, and the source of the RfC/RfD are identified. Only a small fraction of the chemicals have RfCs/RfDs available from IRIS (1997) or HEAST (1995). A few chemicals are represented by provisional values from other sources (ATSDR 1993a,b,c; USEPA, 1995c,d,e). Chemicals lacking toxicity values are not shown in this table. For these chemicals, the oral RfD are used to evaluate inhalation hazards in the quantitative risk assessment.

Dermal

Because dermal exposure is assessed in terms of absorbed dose, the dermal toxicity values must also be expressed in terms of an absorbed dose. This is accomplished by multiplying the oral RfDs by available oral absorption fractions (Owen, 1990; HEAST, 1995). In the absence of data, an oral absorption fraction of 1 is assumed (*i.e.*, 100% of the chemical is absorbed). Dermal RfDs derived

in this manner are shown in Table 4-3. Dermal RfDs are intended to be protective for any systemic effects that may occur following dermal exposure, and may not necessarily be protective for effects occurring at the point of contact (*i.e.*, dermal sensitization, irritation). Nickel and chromium, for example, are two chemicals which are known to produce dermal sensitization.

Total Petroleum Hydrocarbon

Total petroleum hydrocarbon (TPH) contamination at the site were evaluated in the quantitative risk assessment in accordance with guidance from the Bureau of Underground Storage Tank Regulations (BUSTR, 1994). The uncharacterized TPH fraction was treated as an additional noncarcinogen using the toxicity parameters listed below.

CHRONIC TOXICITY VALUES FOR TPH

TPH Source (Group)	RfDo mg/kg-day	RfC mg/cubic meter	TPH Modeling Compound
Group 1 Gasoline Light Distillate	average of TEX	average of TEX	N-Hexane
Group 2 Diesel/Kerosene Middle Distillate	(average of TEX x .28) + average of TEX	(average of TEX x .28) + average of TEX	Naphthalene
Group 3 Lubricating Oil Heavy Distillate	4	GROUP 2 RfC x 4	Heptadecane or Naphthalene

T = Toluene

E = Ethylbenzene

X = Xylene

Reference doses and reference concentrations derived in this manner are presented in Table 4-4. In addition, this analysis was extended to derive PRGs and SSLs for TPH fractions.

4.3 Carcinogenic Health Effects

Oral

Oral unit risks (URs) and slope factors (SFs), and the USEPA's cancer weight-of-evidence classification are shown in Table 4-5. In addition, the test species, tumor site/type, and exposure media from the key study are identified. Noncarcinogens are not presented in this table. A majority of the carcinogens (>50%) have URs/SFs available from IRIS (1997) or HEAST (1995); however, a few chemicals are represented by provisional or surrogate values (USEPA, 1995d,e,f) (Table 4-5). Extrapolations of the SFs for PAHs were made using a relative potency approach (USEPA, 1993). Although cadmium has a cancer weight-of-evidence classification higher than C, this metal is only considered carcinogenic by the inhalation route.

Inhalation

Inhalation URs and SFs, and the USEPA's cancer weight-of-evidence classification are shown in Table 4-6. In addition, the test species, tumor site/type, exposure media, and the source of the UR/SF are identified. Noncarcinogens are not presented in this table. Only a fraction of the carcinogenic PCOIs have URs/SFs available from IRIS (1997) or HEAST (1995). A number of COIs are represented with provisional values either from other sources or are based on route-to-route (oral-to-inhalation) extrapolation. Provisional values are noted as such in Table 4-6. Although nickel (in the form of refinery dust) and chromium (in its hexavalent form) are considered carcinogens by the inhalation, these specific forms of the metals are not expected to occur at the site based upon historical use information. Since inhalation slope factors are not available for bis(2-ethylhexyl)phthalate and n-nitrosodiphenylamine, the oral slope factor values are used as a conservative estimate.

Dermal

Because dermal exposures are evaluated in terms of an absorbed dose, dermal SFs were derived from oral SFs by dividing by the oral absorption fraction. Dermal SFs derived in this manner are shown in Table 4-7. USEPA (1997) has developed a tiered approach for determining the cancer potency of polychlorinated biphenyls (PCBs). Exposure pathways are categorized into three tiers: (1) high risk and persistence (*e.g.*, sediment or soil ingestion, dust inhalation, dermal exposure), (2) low risk and persistence (*e.g.*, ingestion of water-soluble congeners, dermal exposure), or (3) lowest risk and persistence (*e.g.*, congeners with more than four chlorines comprise less than 0.5% of the total PCBs (USEPA, 1997). As shown in Table 4-7, the dermal slope factor used in this assessment is derived from the conservative (*i.e.*, Tier 1 upper bound) slope factor of 2 (mg/kg/day)⁻¹.

There are certain instances when it is not appropriate to extrapolate dermal SFs from oral values. For example, chemicals which act at the point of contact by producing tumors in the upper digestive tract following oral exposure (*i.e.*, carcinogenic PAHs), are more likely to produce skin tumors following dermal exposure. Dermal SFs derived in this manner do not consider skin tumor development, and therefore are not derived for PAHs in this report. For this reason, potential cancer risk from dermal exposure to PAHs can only be addressed qualitatively. The absence of dermal SFs for PAHs and other point-of-contact acting chemicals is identified as a source of uncertainty in the risk assessment (USEPA, 1989a). Values used to assess dermal absorption (ABS, Kp) are summarized in Table 4-8.

TABLE 4-1
ORAL REFERENCE DOSES
(Page 1 of 2)

Chemical	CAS Number	Test Species	Method of Administration	Critical Effect(s)	Subchronic		Chronic		Confidence
					RfD (mg/kg-d)	Source ^a	RfD (mg/kg-d)	Source ^a	
Aroclor-1242	53469-21-9	Monkey	Food	Effects judged to be similar to Aroclor-1016	0.00007	CHR	0.00007	IRIS	Medium
Aroclor-1248	12672-29-6	Monkey	Capsule	Effects judged to be similar to Aroclor-1254	0.00005	SUR	0.00002	SUR	
Aroclor-1254	11097-69-1	Monkey	Capsule	Ocular effects, inflamed meibomian glands, distorted nail growth, decreased antibody response	0.00005	HEAST	0.00002	IRIS	Medium
Aroclor-1260	11096-82-5	Monkey	Capsule	Effects judged to be similar to Aroclor-1254	0.00005	SUR	0.00002	SUR	
Arsenic	7440-38-2	Human	Water, Food	Keratosiis, hyperpigmentation	0.0003	HEAST	0.0003	IRIS	Medium
Benzene	71-43-2	Rat	Gavage	Slight Leukemia	0.0003	CHR	0.0003	ECAO	Low
Benzo(a)anthracene	56-55-3	Mouse	Gavage	Effects judged to be similar to pyrene	0.3	SUR	0.03	SUR	
Benzo(a)pyrene	50-32-8	Mouse	Gavage	Effects judged to be similar to pyrene	0.3	SUR	0.03	SUR	
Benzo(b)fluoranthene	205-99-2	Mouse	Gavage	Effects judged to be similar to pyrene	0.3	SUR	0.03	SUR	
Bis(2-ethylhexyl)phthalate	117-81-7	Guinea pig	Food	Increased liver weight	0.02	CHR	0.02	IRIS	Medium
Cadmium (food,soil)	7440-43-9	Human	Food	Significant proteinuria	0.001	CHR	0.001	IRIS	High
Cadmium (water)	7440-43-9	Human	Water	Significant proteinuria	0.0005	CHR	0.0005	IRIS	High
Chromium (III)	16065-83-1	Rat	Food	None observed	1	HEAST	1	IRIS	Low
Dibenzofuran	132-64-9	Rat	Food	Kidney effects	0.004	CHR	0.004	ECAO	Low
Dichloroethane, 1,2-	107-06-2	Rat	Gavage	General toxicity	0.03	CHR	0.03	ECAO	
Dichloroethene, 1,1-	75-35-4	Rat	Water	Liver lesions	0.009	HEAST	0.009	IRIS	Medium
Dichloroethene, 1,2- (mixed isomers)	540-59-0	Rat	Water	Liver lesions	0.009	HEAST	0.009	HEAST	
Dichloroethene-cis, 1,2-	156-59-2	Rat	Gavage	Hematological changes	0.1	HEAST	0.01	HEAST	
Ethylbenzene	100-41-4	Rat	Gavage	Developmental toxicity	0.1	CHR	0.1	IRIS	Low
Fluorene	86-73-7	Mouse	Gavage	Decreased red blood cell count	0.4	HEAST	0.04	IRIS	Low
Lead	7439-92-1					HEAST		IRIS	
Manganese (soil, water)	7439-96-5	Human	Water	Central nervous system effects	0.047	CHR	0.047	IRIS	
Methylene chloride	75-09-2	Rat	Water	Liver toxicity	0.06	HEAST	0.06	IRIS	Medium
Methylnaphthalene, 2-	91-57-6			Effects judged similar to naphthalene	0.04	SUR	0.04	SUR	
N-nitrosodiphenylamine	86-30-6	Rat	Food	Decreased body weight	0.02	CHR	0.02	ECAO	Low
Naphthalene	91-20-3	Rat	Gavage	Decreased body weight	0.04	CHR	0.04	ECAO	
Nickel	7440-02-0	Rat	Food	Decreased organ and body weight	0.02	HEAST	0.02	IRIS	Medium
Phenanthrene	85-01-8	Mouse	Gavage	Effects judged similar to pyrene	0.3	SUR	0.03	SUR	
Tetrachloroethene	127-18-4	Mouse	Gavage	Liver toxicity	0.1	HEAST	0.01	IRIS	Medium
Toluene	108-88-3	Rat	Gavage	Altered liver and kidney weight	2	HEAST	0.2	IRIS	Medium

TABLE 4-1
ORAL REFERENCE DOSES
(Page 2 of 2)

Chemical	CAS Number	Test Species	Method of Administration	Critical Effect(s)	Subchronic		Chronic		Confidence
					RfD (mg/kg-d)	Source ^a	RfD (mg/kg-d)	Source ^a	
Total Petroleum Hydrocarbons (light)				Effects judged to be similar to toluene, ethylbenzene, xylene, naphthalene, and n-hexane	0.5	CHR	0.5	BUSTR	
Total Petroleum Hydrocarbons (middle)				Effects judged to be similar to toluene, ethylbenzene, xylene, naphthalene, and n-hexane	0.6	CHR	0.6	BUSTR	
Total Petroleum Hydrocarbons (heavy)				Effects judged to be similar to toluene, ethylbenzene, xylene, naphthalene, and n-hexane	1.8	CHR	1.8	BUSTR	
Trichloroethane, 1,1,1-	71-55-6			Liver toxicity	0.09	CHR	0.09	PRG, W	
Trichloroethane, 1,1,2-	79-00-5	Mouse	Water	Hematological effects	0.04	HEAST	0.004	IRIS	Medium
Trichloroethene	79-01-6	Mouse	Water	Liver and kidney effects	0.006	CHR	0.006	ECAO	Low
Vinyl acetate	108-05-4	Rat	Water	Altered body and kidney weight	1	HEAST	1	HEAST	
Vinyl chloride	75-01-4	Rat	Food		0.00002	CHR	0.00002	MRL (ATSDR, 1993b)	
Xylenes	1330-20-7	Rat	Gavage	Decreased body weight, increased mortality, hyperactivity	2	CHR	2	IRIS	Medium

a Codes used:

- BUSTR Calculated per Ohio Bureau of Underground Storage Tank Regulations (BUSTR, 1994).
- CHR Chronic RfD used for subchronic RfD.
- ECAO Value issued by the Environmental Criteria and Assessment Office of the Superfund Technical Support Center (ECAO, 1995).
- HEAST Value from HEAST Table 1 (HEAST, 1995).
- IRIS Value from IRIS database (IRIS, 1996).
- MRL The intermediate minimal risk level (MRL) was used as a surrogate value; source in parentheses.
- PRG Provisional value from USEPA Region IX (PRG, 1996).
- RDA Evaluated using the RDA/EMR/ESADDI (NAS, 1989) for a child (for subchronic RfD) and an adult (for chronic RfD), divided by body weights of 15 and 70 kg, respectively, and multiplied by an uncertainty factor of 2 (see Appendix C).
- SUR Surrogate value used.
- W Value withdrawn from IRIS or HEAST.

TABLE 4-2
INHALATION REFERENCE CONCENTRATIONS AND REFERENCE DOSES
 (Page 1 of 1)

Chemical	CAS Number	Test Species	Critical Effect(s)	Subchronic				Chronic				Confidence
				RfC (mg/m ³)	Source ^a	RfD (mg/kg-d)	Source ^a	RfC (mg/m ³)	Source ^a	RfD (mg/kg-d)	Source ^a	
Benzene	71-43-2			0.006	CHR	0.0017	CHR	0.006	ECAO	0.0017	ECAO	Low
Chromium (III)	16065-83-1	Human	None observed	0.09	CHR	0.026	CALC	0.09	PROV (Finley et al, 1992)	0.026	CALC	
Dichloroethane, 1,2-	107-06-2	Human	Liver, Gastro- Intestinal, Gall bladder	0.005	ECAO	0.0014	CALC	0.005	ECAO	0.0014	CALC	Low
Ethylbenzene	100-41-4	Rat, Rabbit	Developmental toxicity	1	HEAST-1, W	0.29	CALC	1	IRIS	0.29	CALC	Low
Manganese	7439-96-5	Human	Respiratory effects, psychomotor disturbances	0.00005	CHR	0.000014	CALC	0.00005	IRIS	0.000014	CALC	Medium
Methylene chloride	75-09-2	Rat	Liver toxicity	3	HEAST-1	0.86	CALC	3	HEAST-1	0.86	CALC	
Tetrachloroethene	127-18-4	Mouse	Hepatic and Renal effects	0.4	CHR	0.11	CALC	0.4	ECAO	0.11	CALC	Medium
Toluene	108-88-3	Human, Rat	Neurological effects, eye and nose irritation	0.4	CHR	0.11	CALC	0.4	IRIS	0.11	CALC	Medium
Trichloroethane, 1,1,1-	71-55-6		Liver toxicity	10	HEAST-2, W	2.9	CALC			0.29	PRG	
Trichloroethene	79-01-6	Rat	Neurological effects			3.1	CHR			3.1	PROV (ATSDR, 1995)	
Vinyl acetate	108-05-4	Rat, mouse	Nasal epithelial lesions			0.057	CHR	0.2	IRIS	0.057	CALC	High
Vinyl chloride	75-01-4	Rat	Increased liver weight			0.0015	CHR			0.0015	PROV (ATSDR, 1993b)	
Xylenes	1330-20-7					0.086	CHR			0.086	PRG, W	

^a Codes used:

CALC	RfD calculated from the corresponding RfC value assuming a breathing rate of 20 m ³ /day for a 70 kg adult.
CHR	Chronic RfD used for subchronic RfD.
ECAO	Value issued by the Environmental Criteria and Assessment Office of the Superfund Technical Support Center (ECAO, 1995).
HEAST-1	Value from HEAST Table 1 (HEAST, 1995).
HEAST-2	Value from HEAST Table 2 (HEAST, 1995).
IRIS	Value from IRIS database (IRIS, 1996).
PRG	Provisional value from USEPA Region IX (PRG, 1996).
PROV	Provisional value; source in parentheses.
SUR	Surrogate value used; surrogate chemical in parentheses.
W	Value withdrawn from IRIS or HEAST.

TABLE 4-3
DERMAL REFERENCE DOSES
 (Page 1 of 2)

Chemical	CAS Number	Subchronic RfD (mg/kg-day)(a)	Chronic Oral RfD (mg/kg-day)(a)	Oral Absorption Fraction(b)	Subchronic Dermal RfD (mg/kg-day)	Chronic Dermal RfD (mg/kg-day)
Aroclor-1242	53469-21-9	0.00007	0.00007	0.95 (d)	0.0000665	0.0000665
Aroclor-1248	12672-29-6	0.00005	0.00002	0.95 (d)	0.0000475	0.000019
Aroclor-1254	11097-69-1	0.00005	0.00002	0.95 (d)	0.0000475	0.000019
Aroclor-1260	11096-82-5	0.00005	0.00002	0.95 (d)	0.0000475	0.000019
Arsenic	7440-38-2	0.0003	0.0003	0.98 (d)	0.000294	0.000294
Benzene	71-43-2	0.0003	0.0003	1 (d)	0.0003	0.0003
Benzo(a)anthracene	56-55-3	0.3	0.03	1	0.3	0.03
Benzo(a)pyrene	50-32-8	0.3	0.03	1	0.3	0.03
Benzo(b)fluoranthene	205-99-2	0.3	0.03	1	0.3	0.03
Bis(2-ethylhexyl)phthalate	117-81-7	0.02	0.02	1	0.02	0.02
Cadmium (food,soil)	7440-43-9	0.001	0.001	0.025 (e)	0.000025	0.000025
Cadmium (water)	7440-43-9	0.0005	0.0005	0.05 (e)	0.000025	0.000025
Chromium (III)	16065-83-1	1	1	0.01 (d)	0.01	0.01
Dibenzofuran	132-64-9	0.004	0.004	1	0.004	0.004
Dichloroethane, 1,2-	107-06-2	0.03	0.03	1	0.03	0.03
Dichloroethene, 1,1-	75-35-4	0.009	0.009	0.93 (d)	0.00837	0.00837
Dichloroethene, 1,2- (mixed isomers)	540-59-0	0.009	0.009	1	0.009	0.009
Dichloroethene-cis, 1,2-	156-59-2	0.1	0.01	1	0.1	0.01
Dichloroethene-trans, 1,2-	156-60-5	0.2	0.02	1	0.2	0.02
Ethylbenzene	100-41-4	0.1	0.1	0.82 (d)	0.082	0.082
Fluorene	86-73-7	0.4	0.04	1	0.4	0.04
Lead	7439-92-1	--	--	0.2 (c)	--	--
Manganese	7439-96-5	0.047	0.047	0.1 (c)	0.0047	0.0047
Methylene chloride	75-09-2	0.06	0.06	1 (d)	0.06	0.06
Methylnaphthalene, 2-	91-57-6	0.04	0.04	1	0.04	0.04
N-nitrosodiphenylamine	86-30-6	0.02	0.02	1	0.02	0.02
Naphthalene	91-20-3	0.04	0.04	1 (d)	0.04	0.04
Nickel	7440-02-0	0.02	0.02	0.05 (c)	0.001	0.001
Phenanthrene	85-01-8	0.3	0.03	1	0.3	0.03
Tetrachloroethene	127-18-4	0.1	0.01	1	0.1	0.01
Toluene	108-88-3	2	0.2	1 (d)	2	0.2

TABLE 4-3
DERMAL REFERENCE DOSES
 (Page 2 of 2)

Chemical	CAS Number	Subchronic RfD (mg/kg-day)(a)	Chronic Oral RfD (mg/kg-day)(a)	Oral Absorption Fraction(b)	Subchronic Dermal RfD (mg/kg-day)	Chronic Dermal RfD (mg/kg-day)
Trichloroethane, 1,1,1-	71-55-6	0.09	0.09	1	0.09	0.09
Trichloroethane, 1,1,2-	79-00-5	0.04	0.004	1	0.04	0.004
Trichloroethene	79-01-6	0.006	0.006	1	0.006	0.006
Vinyl acetate	108-05-4	1	1	1	1	1
Vinyl chloride	75-01-4	0.00002	0.00002	0.9 (d)	0.000018	0.000018
Xylenes	1330-20-7	2	2	1 (d)	2	2

a See Table 6-1 for source of oral RfDs.

b An oral absorption fraction of 1 is assumed in the absence of data.

c Source = HEAST, Table 4 (HEAST,1995).

d Source = Owen (1990).

e Source = IRIS (IRIS, 1996).

"--" = not available.

TABLE 4-4
RISK ASSESSMENT VALUES FOR TPH FRACTIONS

Group	Fraction	Surrogates	ORfD (mg/kg-day)	IRfD (mg/kg-day)	Soil PRG (mg/kg)		SSL (mg/kg) Leaching (DAF=20)	PRG Tap Water (ug/L)
					Residential	Industrial		
I	Light	toluene	0.2	0.11	790	880	12	720
		ethylbenzene	0.1	0.29	230	230	13	1300
		xylene	2	0.086	320	320	200	1400
		naphthalene	0.04	0.04	240	240	84	240
		n-hexane	0.06	0.057	110	110	NA	350
		Average	0.48	0.12	338	356	77	802
II	Middle	1.28 x Group I	0.61	0.15	433	456	99	1027
III	Heavy	3 x Group II	1.84	0.45	1298	1367	297	3080

TABLE 4-5
ORAL UNIT RISKS AND SLOPE FACTORS
 (Page 1 of 1)

Chemical	CAS Number	WOE ^a	Test Species	Method of Administration ^b	Tumor Site/ Critical Effect(s)	Unit Risk (ug/L) ⁻¹	Source ^b	Slope Factor (mg/kg-d) ⁻¹	Source ^b
Aroclor-1242	53469-21-9	B2	Rat	Food	Liver			2	IRIS
Aroclor-1248	12672-29-6	B2	Rat	Food	Liver			2	IRIS
Aroclor-1254	11097-69-1	B2	Rat	Food	Liver			2	IRIS
Aroclor-1260	11096-82-5	B2	Rat	Food	Liver			2	IRIS
Arsenic	7440-38-2	A	Human	Water	Skin and internal	0.00005	IRIS	1.5	IRIS
Benzene	71-43-2	A	Human	RRE	Leukemia	0.00000083	IRIS	0.029	IRIS
Benzo(a)anthracene	56-55-3	B2	Mouse	Food	Effects judged to be similar to benzo(a)pyrene	0.000021	SUR	0.73	SUR, PF(0.1)
Benzo(a)pyrene	50-32-8	B2	Mouse	Food	Stomach	0.00021	IRIS	7.3	IRIS
Benzo(b)fluoranthene	205-99-2	B2	Mouse	Food	Effects judged to be similar to benzo(a)pyrene	0.000021	SUR	0.73	SUR, PF(0.1)
Bis(2-ethylhexyl)phthalate	117-81-7	B2	Mouse	Food	Liver	0.0000004	IRIS	0.014	IRIS
Cadmium (food,soil)	7440-43-9	B1 (inhalation)							
Dichloroethane, 1,2-	107-06-2	B2	Rat	Gavage	Hemangiosarcomas, stomach	0.0000026	IRIS	0.091	IRIS
Dichloroethene, 1,1-	75-35-4	C	Rat	Water	Adrenal gland	0.000017	IRIS	0.6	IRIS
Lead	7439-92-1	B2			Kidney				
Methylene chloride	75-09-2	B2	Mouse	Water, Inhalation	Liver	0.00000021	IRIS	0.0075	IRIS
N-nitrosodiphenylamine	86-30-6	B2	Rat	Water	Bladder	0.00000014	IRIS	0.0049	IRIS
Trichloroethane, 1,1,2-	79-00-5	C	Mouse	Gavage	Liver	0.0000016	IRIS	0.057	IRIS
Trichloroethene	79-01-6	B2/C			Liver	0.00000032	ECAO	0.011	ECAO
Vinyl chloride	75-01-4	A	Rat	Food	Lung and liver	0.000054	HEAST	1.9	HEAST

a Weight of evidence (WOE) classification:

- A Human carcinogen.
- B1/B2 Probable human carcinogen.
- BC/C Possible/probable human carcinogen.
- C Possible human carcinogen.

b Codes used:

- ECAO Value issued by the Environmental Criteria and Assessment Office of the Superfund Technical Support Center (ECAO, 1995).
- HEAST Value from HEAST Table 3 (HEAST, 1995).
- IRIS Value from IRIS database (IRIS, 1996).
- PF Relative potency factor (USEPA, 1993); value in parentheses.
- RRE Route-to-route extrapolation by USEPA, based on inhalation data.
- SUR Surrogate value used.

TABLE 4-6
INHALATION UNIT RISKS AND SLOPE FACTORS
(Page 1 of 1)

Chemical	CAS Number	WOE(a)	Test Species	Exposure Media	Tumor site/ Critical Effect(s)	Unit Risk (mg/m ³) ⁻¹	Source ^b	Slope Factor (mg/kg-d) ⁻¹	Source ^b
Aroclor-1242	53469-21-9	B2		Food (RRE)	Liver			2	IRIS
Aroclor-1248	12672-29-6	B2		Food (RRE)	Liver			2	IRIS
Aroclor-1254	11097-69-1	B2		Food (RRE)	Liver			2	IRIS
Aroclor-1260	11096-82-5	B2		Food (RRE)	Liver			2	IRIS
Arsenic	7440-38-2	A	Human	Particulate	Lung	0.0043	IRIS	15	CALC
Benzene	71-43-2	A	Human		Leukemia	0.0000083	IRIS	0.029	HEAST
Benzo(a)anthracene	56-55-3	B2			Lung			0.61	ECAO
Benzo(a)pyrene	50-32-8	B2			Lung			6.1	ECAO
Benzo(b)fluoranthene	205-99-2	B2			Lung			0.61	ECAO
Bis(2-ethylhexyl)phthalate	117-81-7	B2							
Cadmium (food,soil)	7440-43-9	B1 (inhalation)	Human	Particulate	Respiratory tract	0.0018	IRIS	6.1	HEAST
Dichloroethane, 1,2-	107-06-2	B2	Rat	Gavage (RRE)	Hemangiosarcomas, stomach	0.000026	IRIS	0.091	HEAST
Dichloroethene, 1,1-	75-35-4	C	Mouse		Kidney	0.00005	IRIS	1.2	HEAST
Lead	7439-92-1	B2							
Methylene chloride	75-09-2	B2	Mouse		Liver and lung	0.00000047	IRIS	0.0016	CALC
N-nitrosodiphenylamine	86-30-6	B2							
Trichloroethane, 1,1,2-	79-00-5	C	Mouse	Gavage (RRE)	Liver	0.000016	IRIS	0.057	HEAST
Trichloroethene	79-01-6	B2/C			Lung	1.70E-06	ECAO	0.006	ECAO
Vinyl chloride	75-01-4	A	Rat		Liver	0.000084	HEAST	0.3	HEAST

a Weight of evidence (WOE) classification:

- A Human carcinogen.
- B1 or B2 Probable human carcinogen.
- B2/C Probable/possible human carcinogen.
- C Possible human carcinogen.

b Codes used:

- ECAO Value issued by the Environmental Criteria and Assessment Office of the Superfund Technical Support Center (ECAO, 1995).
- HEAST Value from HEAST Table 3 (HEAST, 1995).
- IRIS Value from IRIS database (IRIS, 1996).
- PRG Provisional value from USEPA Region IX (PRG, 1996).
- RRE Route-to-route extrapolation by USEPA, based on oral data.
- SUR Surrogate value used; surrogate chemical in parentheses.
- W Value withdrawn from IRIS or HEAST.

TABLE 4-7
DERMAL SLOPE FACTORS
(Page 1 of 1)

Chemical	CAS Number	WOE(a)	Oral Slope Factor (mg/kg-day)-1(a)	Oral Absorption Fraction(b)	Dermal Slope Factor (mg/kg-day)-1
Aroclor-1242	53469-21-9	B2	2	0.95 (c)	2.1E+00
Aroclor-1248	12672-29-6	B2	2	0.95 (c)	2.1E+00
Aroclor-1254	11097-69-1	B2	2	0.95 (c)	2.1E+00
Aroclor-1260	11096-82-5	B2	2	0.95 (c)	2.1E+00
Arsenic	7440-38-2	A	1.5	0.98 (c)	1.5E+00
Benzene	71-43-2	A	0.029	1 (c)	2.9E-02
Benzo(a)anthracene	56-55-3	B2	0.73	1	NA
Benzo(a)pyrene	50-32-8	B2	7.3	1	NA
Benzo(b)fluoranthene	205-99-2	B2	0.73	1	NA
Bis(2-ethylhexyl)phthalate	117-81-7	B2	0.014	1	1.4E-02
Cadmium (soil)	7440-43-9	B1 (inhalation)	--	0.025 (e)	--
Dichloroethane, 1,2-	107-06-2	B2	0.091	1	9.1E-02
Dichloroethene, 1,1-	75-35-4	C	0.6	0.93 (c)	6.5E-01
Lead	7439-92-1	B2	--	0.2 (d)	--
Methylene chloride	75-09-2	B2	0.0075	1 (c)	7.5E-03
N-nitrosodiphenylamine	86-30-6	B2	0.0049	1	4.9E-03
Trichloroethane, 1,1,2-	79-00-5	C	0.057	1	5.7E-02
Trichloroethene	79-01-6	B2/C	0.011	1	1.1E-02
Vinyl chloride	75-01-4	A	1.9	0.9 (c)	2.1

a See Table 4 for source of oral slope factors.

b An oral absorption fraction of 1 is assumed in the absence of data.

c Source = Owen (1990).

d Source = HEAST, Table 4 (HEAST, 1995).

e Source = IRIS (IRIS, 1996).

--" = not available.

Table 4-8
Dermal Absorption Parameters

Chemical	ABS	Kp
Aroclor-1242	0.06	0.04
Aroclor-1248	0.06	0.73
Aroclor-1254	0.06	0.57
Aroclor-1260	0.06	0.22
Arsenic	0.01	0.00
Benzene	0.25	0.11
Benzo(a)Anthracene	0.10	0.81
Benzo(a)Pyrene	0.10	1.20
Benzo(b)Fluoranthene	0.10	1.11
Bis(2-Ethylhexyl)Phthalate	0.10	0.03
Cadmium	0.01	0.00
Chromium	0.01	0.00
Dibenzofuran	0.10	0.15
Dichloroethane, 1,2-	0.25	0.01
Dichloroethene, 1,1-	0.25	0.02
Dichloroethene, 1,2-	0.25	0.01
Dichloroethene, Cis-1,2-	0.25	0.01
Ethylbenzene	0.25	1.00
Fluorene	0.10	0.36
Lead	NA	NA
Manganese	NA	NA
Methylene Chloride	0.25	0.00
Methylnaphthalene, 2-	0.10	0.14
Naphthalene	0.10	0.07
Nickel	0.01	0.00
N-Nitrosodiphenylamine	0.10	0.02
Phenanthrene	0.10	0.23
Tetrachloroethene	0.25	0.37
Toluene	0.25	1.00
Total Petroleum Hydrocarbons	0.10	0.07
Trichloroethane, 1,1,1-	0.25	0.02
Trichloroethane, 1,1,2-	0.25	0.01
Trichloroethene	0.25	0.23
Vinyl Acetate	0.25	NA
Vinyl Chloride	0.25	0.01
Xylenes	0.25	0.09

5.0 EXPOSURE ASSESSMENT

Exposure assessment is the process of estimating the magnitude, frequency, duration, and type of potential exposures to site-related chemicals. For the purpose of characterizing potential exposures, the site is divided into four operable units (Figure 2-2) with varying levels and types of contaminants and exposure potentials as described in Section 2.

- Operable Unit 1 (OU1) consists of the active production area west of the Main Drainage Ditch and north of the former Air Force Plant 36.
- Operable Unit 2 (OU2) consists of active production areas and is the former Air Force Plant 36.
- Operable Unit 3 (OU3) consists of SWMUs 17-19 (Reading Road Landfill, Sludge Basin Landfill, East Landfarm).
- Operable Unit 4 (OU4) consists of SWMUs 27-31 (Lime Precipitation Basins).

5.1 Identification of Exposure Scenarios

Exposure scenarios were developed based on the conceptual exposure model presented in the approved Risk Assessment Work Plan (Appendix A).

5.1.1 Potential On-Site (GEAE Property) Exposures

Potential on-site exposure scenarios are summarized in Table 5-1 and described briefly below.

Operable Units 1 and 2

Operable Units 1 and 2 are active industrial areas with access restrictions (*i.e.*, fencing) and will remain active industrial into the foreseeable future. A residential scenario is not considered to be plausible for this area. Three worker scenarios were developed to evaluate potential exposures at the Facility.

General Worker (Outdoor) Scenario - A general worker is considered appropriate under current and plausible future conditions for OU1 and OU2 since these are active industrial areas. However, for baseline assessment purposes, the General Worker is assumed to spend the majority of his time outdoors and to have direct contact with COIs in surface soil. Although most routine work is conducted indoors, this assumption conservatively evaluates potential exposures that occur at outdoor locations and is referred to as the General Worker. Potentially complete exposure pathways for the General Worker Scenario include surface soil via ingestion, dermal contact, and inhalation of particulates. The General Worker scenario also includes exposure to VOCs in ambient air via

inhalation. Since chemicals in air are not restricted to a single location, estimated ambient air concentrations include combined volatile emissions from OU1 and OU2.

Excavation Worker Scenario - Because small scale excavations (*i.e.*, laying down a footer for a new building, sewer line repair) may occur in OU1 and OU2, an Excavation Worker Scenario is considered appropriate. Exposures associated with this scenario are expected to be relatively brief (less than 30 days), but more intensive than those experienced by an outdoor general worker. Potentially complete exposure pathways for the Excavation Worker Scenario include total (surface and subsurface) soil via ingestion, dermal contact, and inhalation of vapors and particulates, and perched groundwater via dermal contact. Because the Excavation Worker is assumed to work on the sewer system and sumps, this receptor may also be exposed to sediment via ingestion and dermal contact. Inhalation of particulate borne contaminants from sediments is not a complete exposure pathway because (1) sediments are generally damp and, therefore, not susceptible to dust generation and (2) sediments are present only within the sumps and sewer system and enclosed spaces such as these are not conducive to wind borne dust generation.

Indoor Worker Scenario - Because groundwater at OU1 and OU2 is relatively shallow in some areas, and was found to contain detectable concentration of VOCs, there is a potential for migration into on-site buildings. Therefore an Indoor Worker Scenario is evaluated for exposure to VOCs in indoor air as a result of volatilization from perched groundwater and vapor intrusion.

Operable Unit 3

All of the land within OU3 is zoned industrial. This land is owned by GEAE but is inactive. GEAE leases property within OU3 to a farmer on a yearly basis. This farmer is the only resident within OU3. Access is restricted to OU3 and additional populations are unlikely to be present for extended time periods. GE has no plans to sell or lease additional land in this area for residential or agricultural use. A resident farmer is evaluated for OU3 as described below. Because the potential exposures to a resident are more conservative (with respect to exposure frequency and duration) than a worker and this area is inactive, a worker scenario is not evaluated for OU3 unless residential exposures (*i.e.*, risks) are determined to be unacceptable.

Resident Scenario - The resident farmer at OU3 raises both crops and livestock. He maintains a vegetable garden and livestock pens near the house, and plants soybeans and/or corn in fields on and near SWMUs 18 and 19 (Figure 2-2). Potable water is supplied by the City of Cincinnati Water Works and no wells exist in this area, therefore, there is no groundwater exposure to this receptor. No COIs were identified in soil at OU3, therefore, the only complete exposure pathway is inhalation of airborne contaminants transported from OU1 and OU2. Chemicals of Interest were selected based on comparison to occupational PRGs as described in the approved Risk Assessment Workplan (Appendix A). A comparison of the maximum detected concentration of all chemicals detected in OU3 soils to residential PRGs is provided in Section 5.1.3.

Operable Unit 4

Operable Unit 4 is currently inactive, however, workers may visit this area for occasional maintenance, therefore a General Worker (Outdoor) scenario is evaluated. This scenario is considered to be conservative under current conditions and plausible for future conditions. Because OU4 consists primarily of fill material, an excavation worker scenario is not considered plausible.

General Worker (Outdoor) - Complete exposure pathways for the General Worker (Outdoor) Scenario include ingestion, dermal contact, and inhalation of particulates from surface soil and inhalation of VOCs transported in air from OU1 and OU2.

5.1.2 Potential Off-Site Exposures

Nearby (off-site) residents and workers may be exposed to airborne COIs transported from on-site soil. Exposure to off-site receptors is not quantitatively evaluated because:

- exposures to off-site workers will be less than those estimated for the on-site worker scenarios; and
- off-site residential (off-site) exposures will be no greater than those estimated for the residential receptor evaluated at OU3.

As described in Section 2, area residents are supplied with potable water by the various municipalities. Potential residential (off-site) exposures to groundwater are not included in the quantitative exposure assessment. A complete discussion of groundwater quality at the site and potential for migration to off-site locations is provided in Appendix D.

5.1.3 Comparison to Residential PRGs

As noted previously, residential development of the GEAE Facility (OU1 and OU2) or the additional GEAE property east of the Facility (OU3 and OU4) is highly unlikely. These areas are zoned industrial and GE has no plans to sell or lease property for residential use. The single resident currently leasing property from GE (OU3) is evaluated as described in Section 5.1.1. A complete evaluation of the demographics of this area, including zoning, land-use plans, and population growth statistics, is presented in the Risk Assessment Workplan (Appendix A). This demographic information indicates that there are no plans for residential development of the GEAE property. Since residential development is not a plausible scenario at this site, residential exposures are evaluated only at OU3 where there is currently one resident.

While a quantitative residential risk assessment is not appropriate for the GEAE Facility, it may be useful to know whether or not land use at the Facility must be restricted to nonresidential. To provide information regarding the feasibility of unrestricted land use of all the GEAE property, the maximum concentrations of all chemicals detected in surface soil are compared to residential

Preliminary Remediation Goals (PRG; USEPA, 1996a). The results of this comparison are provided in Tables 5-2 through 5-5. Preliminary Remediation Goals are not available for calcium, iron, magnesium, or potassium because these metals are essential nutrients.

5.2 Fate and Transport Modeling

Three air pathway scenarios are potentially complete at GEAE Evendale: particulate suspension of contaminated dust (fugitive dust), volatilization of chemicals in soil to ambient air, and volatilization of chemicals from groundwater beneath the facility into the indoor air of plant buildings. USEPA recommended mathematical models were used to quantify emissions from these sources and to predict ambient air concentrations for potential receptors.

5.2.1 Fugitive Dust

Exposure to fugitive dust is evaluated through the use of Particulate Emission Factors (PEFs) (RAGs, Part B (USEPA 1991)). Concentrations of particle bound contaminants in air are estimated as:

$$C_{PM10} = C_{soil}/PEF \quad (1)$$

Where:

C_{PM10}	=	Concentration of contaminants in air carried on respirable (<10 μ m) particles.
C_{soil}	=	Concentration of contaminants in soil acting as a source of airborne contamination (mg/kg).
PEF	=	Particulate emission factor (m ³ /kg).

Particulate Emission Factors are calculated for particle suspension resulting from (1) ambient wind on surface soil and (2) an excavation or earth-moving operation. The PEF is a measure of the amount of particulate suspension that may result from these disturbances. PEF values are calculated using meteorological information, soil characteristics, and values ascribed to some of the physical and kinetic processes of earthmoving and excavation.

5.2.1.1 Wind Generated Particulate Emissions

The PEF calculated for evaluation of the General Worker scenario is based on the suspension of particulates resulting from ambient wind acting on exposed surface soil. USEPA default values are used for the modeling parameters and are summarized in Table 5-6. A complete description of the PEF equation is provided in Appendix C.

5.2.1.2 Particulate Emissions During Excavation

The PEF calculation for the excavation scenario includes contributions of suspended dust resulting from wind, vehicle travel, and earthmoving activities. The excavation scenario is quantitatively evaluated using methods suggested in the *Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites* (USEPA 1984) and the *Hazardous Waste TSD – Fugitive Particulate Matter Air Emissions Guidance Document* (USEPA 1989). It should be noted that relatively small excavations are expected to occur on occasion such as trenching. For example, if excavation occurs, it is most likely to be a utility line or similar small scale excavation. The hypothetical excavation scenario evaluated here assumes a 10,000 m² excavation (approximately the size of 2 football fields). The size of the hypothetical excavation was conservatively chosen to be many times the size of any expected earth-moving activity. Offsite dispersion and deposition modeling were not necessary since: (1) the anticipated size (utility line trench) of the excavation and duration (less than 30 days) of the earth-moving activity are likely to be 10- to 100-fold less than that assumed to calculate the PEF, and (2) the risks estimated for long-term exposure to on-site fugitive dust by general workers are insignificant (Section 6) and (3) off-site residential exposures would be much less due to their distance from the source.

Modeling parameters used for this scenario are summarized and referenced in Table 5-7. A complete description of the equations to calculate PEFs is provided in Appendix C. The resultant PEF for excavation and earthmoving activities is 1.04 E+7 m³/kg (Table 5-7).

5.2.2 Volatile Emissions in Ambient Air

According to RAGS, Part B (USEPA, 1991b), a volatile compound is defined as any chemical with a molecular weight less than 200 g/mole and a Henry's Law Constant greater than 1×10^{-5} atm-m³/mol. Based on this designation, all chemicals detected in soil are categorized as either volatile or nonvolatile for modeling purposes. Two volatile chemicals are identified in total soil at OU1 (Figure 3-3) - trichloroethylene and vinyl chloride. The only volatile COI identified in soil at OU2 is benzene (Figure 3-13). No volatile COIs are identified in soil at OU3 or OU4. Therefore, volatile emissions are only modeled from OU1 and OU2.

The USEPA suggests the use of average chemical concentrations for determining emission rates for evaluating short- and long-term releases (USEPA 1988, 1996). Average soil chemical concentrations computed using the arithmetic mean, as described in Section 3.1.3 of this assessment, are used in calculating emission flux rates and are presented in Tables 3-15 and 3-40 for Operable Units 1 and 2.

The evaluation of volatile emissions consists of two parts: (1) emission from soil and (2) dispersion in air. Emission from soil is modeled using the Behavior Assessment Model (BAM) (Jury *et al.*, 1983) to calculate flux rates in units of mass per unit area and time. The flux output of the BAM became the input for modeling dispersion of VOCs to potential receptor locations using the

Industrial Source Complex - Short Term (version 3) ISCST3 air dispersion model to produce chemical concentrations in air in mass per unit volume. These two models and their application at the GEAE-Evendale Facility are described in Appendix C of this report.

Modeled VOC Emissions from Soil

Most soil parameters for flux modeling (porosity, bulk density, etc.) are taken from conservative *Soil Screening Guidance: User's Guide* (USEPA 1996) default values. A qualitative evaluation of depth versus chemical concentration at the site shows that COIs in soil varied in depth and concentration. As the BAM assumes that chemicals are present homogeneously at a given concentration within a soil zone, it was necessary to construct a depth profile of the VOCs. VOCs in Operable Unit 1 soil are conservatively assumed to be located uniformly to a depth of 22 feet, which represents the entire extent of total soil sampling. Similarly, VOCs in Operable Unit 2 soil are assumed to be located uniformly to a depth of 30 feet. The depth profiles used in this evaluation err on the side of conservatism for all areas as the model used values that overestimate true depths of chemicals. Further, the emission modeling approach used here did not account for the pavement, concrete, and buildings on the site that would preclude or decrease VOC emissions to the surface. Modeling the emissions of chemicals through these layers and structures would reduce the emission rate. Input parameters and references used in the BAM are summarized in Table 5-8.

Average emission fluxes were calculated over various exposure periods. The exposure duration relevant to each scenario was assumed to be 4.2 and 25 years for MLE and RME General Worker, and 9 and 30 years for the residential scenario.

Calculated emission fluxes are shown in Table 5-9. The BAM output is included in the diskette provided with Appendix C.

VOC Dispersion Modeling

Air dispersion models range from simple mass-balance air exchange calculations to complicated, multi-source Gaussian dispersion models that account for particle deposition and complex topographic features. The model used in this evaluation is the ISCST3 (USEPA, 1995d). The ISCST3 is an air dispersion model specifically designed for computing concentration and deposition impacts from various emission sources.

The ISCST3 is used to estimate ambient air concentrations of VOCs resulting from emissions from soil. The principal data requirements for this model are (1) source emission rates and (2) site-specific meteorological data consisting of wind speed, wind direction, and atmospheric stability. This type of model does not attempt to describe instantaneous conditions, but rather time-averaged conditions. Accordingly, annual averages of vapor emission rates are used to predict annual average air concentrations in ambient air.

Operable Units 1 and 2 are characterized as two distinct emission sources due to marked differences in geography, geology, industrial functionality, and chemical contamination. The Operable Units

are further subdivided into source areas (Figure 5-1) since ISCST3 requires that area sources be rectangular. Areas completely covered by buildings will not act as sources since these structures will prevent the release of VOCs from the underlying soil. Source areas are identified based on site maps and aerial photographs. Source areas include sub-regions of OU1 and OU2 not covered by the central row of main plant buildings. The entire areal dimensions of each source area are used in the dispersion modeling regardless of cover. This is conservative since these source areas do have buildings, pavement, and other flux inhibiting cover. Most source areas to the west of the main corridor of buildings are actually paved parking lots. Ten source areas (OU1-1 through OU1-10) are identified at OU1 and five source areas (OU2-1 through OU2-5) are identified at OU2. The input parameters for each source area are summarized in Table 5-10.

The ISCST3 model calculates airborne concentrations at receptor locations defined by a grid with nodes 100 meters apart with the intersection of the X-Y axis located to the Southwest of the facility. The receptor grid covers an approximate area of 5 km² and is shown in Figure 5-2.

Meteorological data (*i.e.*, temperature, wind speed, wind direction, etc.) from the Cincinnati - Covington Airport National Weather Service station for 1987 – 1991 are used in ISCST3 (USEPA, 1995e). The Covington airport is located approximately 20 miles from the GEAE Evendale facility and is considered to adequately represent the meteorology in the area. To evaluate air concentrations in the breathing zone, a receptor height of two meters is used in the modeling analysis.

Dispersion model inputs and outputs are presented in the diskette provided with Appendix C. Exposure point concentrations calculated using the ISCST3 model are presented in Tables 5-15 through 5-18.

5.2.3 VOC Emissions to Indoor Air

Volatile chemicals may be emitted from groundwater to air due to volatilization of dissolved form in the water phase to the vapor phase in air. Chemicals located in the upper perched aquifer beneath the buildings of OU1 and OU2 are assumed to volatilize through the soil column and into the indoor air of the buildings. No volatile COIs are identified in the groundwater beneath OU3 and OU4.

Emission Modeling

The BAM by Jury *et al.* (1983) modified to include emissions from groundwater sources is selected to predict vapor flux to buildings resulting from VOCs in groundwater. The resultant chemical fluxes from groundwater sources are combined with a simple mass balance indoor box model to quantify the concentrations of VOCs in indoor air. In most respects, the BAM, modified for prediction of volatilization from groundwater sources, is identical to the BAM for volatilization from soil. The factors unique to the groundwater volatilization scenario are discussed in Appendix C.

The upper perched groundwater table is conservatively estimated to be 4 feet below the surface. This assumption resulted from a qualitative study of RFI soil cross sections. This was the highest

extent of groundwater and is not necessarily representative of conditions throughout the site. In most cases, the perched aquifer is at a depth of 10 feet or more. The groundwater depth is considered to be a conservative parameter chosen to be protective of indoor workers. Soil parameters remained consistent with those used to model volatilization from soil. Again, these parameters are conservative as they are taken from USEPA defaults. The 95th UCL concentration of each volatile COI identified in the perched groundwater is used in calculating VOC emissions from groundwater. The UCL concentrations in groundwater are presented in Tables 3-30 and 3-54. Modified BAM inputs and references are shown in Table 5-11 for Operable Unit 1 and Table 5-12 for Operable Unit 2. Flux from groundwater sources is shown in Table 5-13.

Indoor air concentration of a chemical is a function of leakage area, air exchange rate, and room volume. The leakage area is equal to the leakage ratio (*i.e.*, the area of cracks or foundation penetration per floor area) multiplied by the emission area. Leakage ratio is generally dependent on the type of foundation (raised versus slab) and the age of the structure. Typical leakage ratios have been found to be in the range of 1 to 10 cm²/m² (Grimsrud *et al.*, 1983). Although the leakage ratio for an on-site structure is expected to be at the low end of this range, the more conservative value of 10 cm²/m² is used in the model. The emission area is arbitrarily set at 15 m² (5m x 3m) for the industrial indoor worker scenario. It is important to note that the predicted concentration of VOCs in a room relies on the height of the room, not on the base area.

The ventilation rate for a typical workplace is a function of volume of air in the room and number of air changes per second. A 3 m ceiling height was assumed for this industrial scenario. The number of air changes per second at a particular location within a building may not be known with any certainty. For the purposes of this assessment, the ventilation is assumed to be at the rate of one exchange every hour (ASHRAE, 1981). Indoor parameter values used to estimate indoor air concentrations are shown in Table 5-14. A complete description of the Indoor Air modeling is provided in Appendix C. Resultant indoor air exposure point concentrations are shown in Tables 5-15 (OU1) and 5-16 (OU2).

5.3 Quantification of Exposure

Exposures are quantified by calculating average daily doses (ADDs) and lifetime average daily doses (LADDs) for each of the exposure scenarios identified in Section 5.1. As described in the workplan, two levels of exposure are quantified: (1) most likely exposure (MLE) conditions, and (2) reasonable maximum exposure (RME) conditions. The equations used to calculate ADDs and LADDs are provided in the Risk Assessment Workplan (Appendix A). Additional exposure equations not included in the workplan are provided below (Section 5.3.1). Exposure point concentrations (EPCs) for all media are summarized in Tables 5-15 through 5-18. Exposure point concentrations are calculated as described in Section 5.2 (air) and Section 3.0 (soil, sediment, groundwater). Other exposure parameter values used to calculate ADDs and LADDs are summarized in Table 5-19. Chemical-specific dermal absorption parameters (ABS, K_p) are provided in Table 4-8. A description of the selection of appropriate exposure parameters is provided in the Risk Assessment Workplan

(Appendix A) for most of the parameters used. The selection of parameters not included in the workplan is described below (Section 5.3.2).

5.3.1 Additional Exposure Equations

Exposure Via Inhalation of Particulates:

$$LADD / ADD = \frac{C_{soil} * PEF * IR * EF * ED * ET * CF}{BW * AT} \quad (2)$$

Where:

PEF = Particulate Emission Factor (m³/kg).

All other parameters as defined in the Risk Assessment Workplan (Appendix A).

Particulate emission factors are calculated as described in Section 5.2 and summarized in Tables 5-6 (General Worker) and 5-7 (Excavation Worker).

5.3.2 Additional Exposure Parameters

Excavation Worker

The Excavation Worker is assumed to spend a standard 8 hour workday at the Facility. However, much less than the full day will be spent in contact with groundwater. Exposure times of 0.5 (MLE) and 1 (RME) hours/day are assumed for dermal contact with groundwater.

The Excavation Worker represents a short-term exposure scenario. Excavation workers may be involved in digging an excavation for a building footer, excavating a utility line, or servicing a sump. These types of activities can generally be completed within a few days or at most weeks. Exposure frequencies of 5 days/year (1 week - MLE) and 20 days/year (4 weeks - RME) are combined with a 1 year exposure duration based on the anticipated duration of these types of activities.

Excavation Workers are assumed to contact and ingest sediment from the sewer system as well as soil. Exposure parameters specific to sediment contact are not available, therefore, sediment ingestion rates, adherence factors, and available skin surface area are set equal to those recommended for soil exposure.

Resident

Estimated residential exposures are based on a combined child/adult scenario. An age adjusted intake is calculated for the residential scenario as shown in Table 5-20. This age adjusted intake takes the place of the inhalation rate, exposure duration, and body weight parameters in the ADD/LADD equations for this scenario. In calculating age adjusted intakes, the exposure duration

is divided into 6 years as a child (age 0-6) plus 3 years as a youth (age 6-9) for the MLE (total ED = 9 years) and 6 years as a child plus 24 years as an adult for the RME (Total ED = 30 years) as recommended by the USEPA (1991 RAGs Part B). Default body weights of 15 kg and 36 kg for the child and youth are used for both the MLE and RME scenarios (USEPA, 1989a).

Calculated ADDs and LADDs are provided in Tables 5-21 through 5-36. These values are used to determine the hazard indices and cancer risk estimates presented in Section 6.0.

TABLE 5-1
SUMMARY OF EXPOSURE SCENARIOS EVALUATED IN THE QUANTITATIVE RISK ASSESSMENT
GEAE EVENDALE
(Page 1 of 2)

Receptor	Exposure Medium	Exposure Route	Pathway Complete?	Comments
General Worker (Outdoor)	Surface Soil	Dermal Contact Ingestion Inhalation (particulates)	Yes Yes Yes	The General Worker is assumed to spend the majority of his time outdoors.
	Ambient Air	Inhalation (VOCs)	Yes	Exposure to chemicals in ambient air includes combined emissions from OU1 and OU2.
Excavation Worker	Total Soil	Dermal Contact Ingestion Inhalation (particulates)	Yes Yes Yes	
	Sediment	Dermal Contact Ingestion	Yes Yes	The Excavation Worker is assumed to enter sewers and sumps and may contact sediment.
		Inhalation (particulates)	No	Sediments in enclosed sewers and sumps are not subject to fugitive dust generation.
	Perched Groundwater	Dermal Contact Ingestion	Yes No	Potable water is provided by the municipal water supply.
		Inhalation	No	Expected to be insignificant based on estimates for the General Worker.
Indoor Worker	Indoor Air	Inhalation (VOCs)	Yes	VOCs released from perched groundwater may infiltrate buildings through cracks in the foundation.

TABLE 5-1
SUMMARY OF EXPOSURE SCENARIOS EVALUATED IN THE QUANTITATIVE RISK ASSESSMENT
GEAE EVENDALE
(Page 2 of 2)

Receptor	Exposure Medium	Exposure Route	Pathway Complete?	Comments
OPERABLE UNIT 3				
Resident	Surface Soil	All	No	No COIs were identified in surface soil at OU3
	Crops and Livestock	Ingestion	No	No COIs were identified in surface soil at OU3
	Ambient Air	Inhalation	Yes	Exposure concentrations in ambient air are assumed to result from VOC emissions from total soil at OU1 and OU2.
	Groundwater	All	No	This area is serviced by a municipal water supply. No potable wells exist in this area.
OPERABLE UNIT 2				
General Worker (Outdoor)	Surface Soil	Dermal Contact Ingestion Inhalation (particulates)	Yes Yes Yes	The General Worker is assumed to spend the majority of his time outdoors.
	Ambient Air	Inhalation (VOCs)	Yes	Exposure to chemicals in ambient air includes combined emissions from OU1 and OU2.
RESIDENTIAL				
Worker	All	All	No	On-site worker scenarios provide a conservative exposure estimate.
Resident	All	All	No	On-site (OU3) residential scenario provides a conservative exposure estimate.

TABLE 5-2
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF PCOIs
IN SURFACE SOIL TO RESIDENTIAL HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 2)

Chemical	Concentration (mg/kg)		Above PRG?
	Site Maximum ^a	PRG ^b	
Acetone	3.3E-01	2.1E+03	No
Aluminum	1.4E+04	7.7E+04	No
Antimony	1.5E+01	3.1E+01	No
Aroclor-1248	3.9E+02	6.6E-02	Yes
Arsenic	1.2E+01	2.2E+01	No
Barium	1.2E+02	5.3E+03	No
Benzo(a)Anthracene	3.9E-01	6.1E-01	No
Benzo(a)Pyrene	3.6E-01	6.1E-02	Yes
Benzo(b)Fluoranthene	5.4E-01	6.1E-01	No
Benzo(ghi)Perylene	2.3E-01	1.0E+02 ^c	No
Benzo(k)Fluoranthene	2.1E-01	6.1E+00	No
Beryllium	1.0E+00	1.4E-01	Yes
Cadmium	3.2E+02	3.8E+01	Yes
Calcium	1.8E+05	NA	NA
Chromium	1.9E+02	2.1E+02 ^d	No
Chrysene	4.1E-01	7.2E+00	No
Cobalt	1.3E+02	4.6E+03	No
Copper	1.3E+02	2.8E+03	No
Cyanide	5.5E+00	1.3E+03	No
Dichloroethene, 1,2-	6.9E+00	3.5E+01	No
Dichloroethene, Trans-1,2-	9.1E-02	7.8E+01	No
Ethylbenzene	1.3E-01	2.3E+02	No
Fluoranthene	1.1E+00	2.6E+03	No
Hexanone, 2-	7.3E-02	NA	NA
Indeno(1,2,3-cd)Pyrene	2.7E-01	6.1E-01	No
Iron	2.2E+04	NA	NA
Lead	4.2E+02	4.0E+02	Yes
Magnesium	3.9E+04	NA	NA
Manganese	4.9E+04	3.2E+03	Yes
Mercury	4.0E-01	2.3E+01 ^e	No
Methyl Ethyl Ketone	2.5E-02	7.1E+03	No
Methylene Chloride	1.3E-02	7.8E+00	No
Methylnaphthalene, 2-	6.8E-01	2.4E+02 ^f	No
Nickel	1.1E+03	1.5E+03	No
Phenanthrene	8.5E-01	1.0E+02 ^c	No
Potassium	2.7E+03	NA	NA

TABLE 5-2
OPERABLE UNIT 1:
COMPARISON OF CONCENTRATIONS OF PCOIs
IN SURFACE SOIL TO RESIDENTIAL HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 2 of 2)

Chemical	Concentration (mg/kg)		Above PRG?
	Site Maximum ^a	PRG ^b	
Pyrene	8.8E-01	1.0E+02	No
Selenium	1.9E-01	3.8E+02	No
Silver	3.0E+00	3.8E+02	No
Sodium	4.2E+03	NA	NA
Tetrachloroethene	1.0E-01	5.4E+00	No
Thallium	2.3E-01	6.1E+00 ^g	No
Toluene	2.4E-02	7.9E+02	No
Total Petroleum Hydrocarbons	4.6E+04	3.4E+02^h	Yes
Trichloroethane, 1,1,1-	3.0E+02	1.2E+03	No
Trichloroethene	8.0E+00	3.2E+00	Yes
Vanadium	3.1E+01	5.4E+02	No
Xylenes	3.9E+00	3.2E+02	No
Zinc	7.9E+02	2.3E+04	No

a Data from Table 3-16.

b Preliminary remediation goals (PRGs) for residential soil (USEPA, 1996a).

c Value for pyrene used as a surrogate.

d Value for total chromium.

e Value for mercuric chloride.

f Value for naphthalene used as a surrogate.

g Value for thallium chloride.

h Average PRG for total petroleum hydrocarbons (see Section 5.0).

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 5-3
OPERABLE UNIT 2:
COMPARISON OF CONCENTRATIONS OF PCOIs IN
SURFACE SOIL TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above PRG?
	Site Maximum^a	PRG^b	
Acetone	2.1E-02	2.1E+03	No
Ethylbenzene	1.3E-01	2.3E+02	No
Tetrachloroethene	3.5E-02	5.4E+00	No
Toluene	3.5E-02	7.9E+02	No
Total Petroleum Hydrocarbons	2.5E+03	3.4E+02^c	Yes
Trichloroethane, 1,1,1-	7.0E-03	1.2E+03	No
Trichloroethene	3.5E-02	3.2E+00	No
Xylene, O-	1.7E-01	3.2E+02	No
Xylenes	2.2E-01	3.2E+02	No

a Data from Table 3-41.

b Preliminary remediation goals (PRGs) for residential soil (USEPA, 1996a).

c Average PRG for total petroleum hydrocarbons (see Section 4.0).

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 5-4
OPERABLE UNIT 3:
COMPARISON OF CONCENTRATIONS OF PCOIs IN
SURFACE SOIL TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above PRG?
	Site Maximum ^a	PRG ^b	
Aluminum	7.7E+04	7.7E+04	No
Antimony	7.0E+00	3.1E+01	No
Arsenic	1.8E+01	2.2E+01	No
Barium	4.4E+02	5.3E+03	No
Beryllium	2.7E+00	1.4E-01	No ^c
Cadmium	1.9E+00	3.8E+01	No
Calcium	1.5E+05	NA	NA
Chromium	1.2E+02	2.1E+02 ^d	No
Cobalt	3.7E+01	4.6E+03	No
Copper	1.3E+02	2.8E+03	No
Cyanide	1.6E+00	1.3E+03	No
Iron	1.9E+04	NA	NA
Lead	6.5E+01	4.0E+02	No
Magnesium	3.0E+04	NA	NA
Manganese	9.4E+02	3.2E+03	No
Mercury	6.0E-01	2.3E+01 ^e	No
Nickel	1.3E+02	1.5E+03	No
Potassium	1.6E+03	NA	NA
Selenium	4.0E+00	3.8E+02	No
Silver	3.4E+01	3.8E+02	No
Toluene	2.6E-02	7.9E+02	No
Total Petroleum Hydrocarbons	2.2E+02	3.4E+02 ^f	No
Vanadium	4.5E+01	5.4E+02	No
Zinc	9.2E+01	2.3E+04	No

^a Data from Table 3-64.

^b Preliminary remediation goals (PRGs) for residential soil (USEPA, 1996a).

^c Eliminated from further consideration since maximum concentration is within Ohio farm soil background range of 0.1 to 3.2 mg/kg for beryllium (Cox and Colvin, 1996); see Section 3.1.2.

^d Value for total chromium.

^e Value for mercuric chloride.

^f Average PRG for total petroleum hydrocarbons (see Section 4.0).

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 5-5
OPERABLE UNIT 4:
COMPARISON OF CONCENTRATIONS OF PCOIs IN
SURFACE SOIL TO HEALTH-BASED BENCHMARKS
GEAE EVENDALE
(Page 1 of 1)

Chemical	Concentration (mg/kg)		Above PRG?
	Site Maximum ^a	PRG ^b	
Aluminum	2.4E+04	7.7E+04	No
Antimony	2.6E+01	3.1E+01	No
Arsenic	2.3E+02	2.2E+01	Yes
Barium	6.3E+02	5.3E+03	No
Beryllium	5.6E-01	1.4E-01	Yes
Cadmium	5.1E+01	3.8E+01	Yes
Calcium	3.2E+05	NA	NA
Chromium	3.2E+02	2.1E+02 ^c	Yes
Cobalt	2.6E+01	4.6E+03	No
Copper	1.6E+03	2.8E+03	No
Cyanide	9.2E-01	1.3E+03	No
Iron	2.7E+04	NA	NA
Lead	3.5E+03	4.0E+02	Yes
Magnesium	2.1E+04	NA	NA
Manganese	2.6E+02	3.2E+03	No
Mercury	1.9E+00	2.3E+01 ^d	No
Nickel	8.8E+02	1.5E+03	No
Potassium	2.0E+03	NA	NA
Selenium	4.8E+00	3.8E+02	No
Silver	2.0E+00	3.8E+02	No
Sodium	2.9E+03	NA	NA
Thallium	1.1E+00	6.1E+00 ^e	No
Vanadium	1.6E+03	5.4E+02	Yes
Zinc	1.1E+04	2.3E+04	No

a Data from Table 3-76.

b Preliminary remediation goals (PRGs) for residential soil (USEPA, 1996a).

c Value for total chromium.

d Value for mercuric chloride.

e Value for thallium chloride.

NA Not available.

Bolded chemicals were detected at concentrations potentially elevated above benchmarks.

TABLE 5-6
ESTIMATION OF PARTICULATE EMISSION FACTOR:
GENERAL WORKER

			Source
Dispersion Factor:	Q/C =	27.67 g/m ² -sec per kg/m ³	USEPA 1996
Fraction of Vegetative Cover:	V =	0.75	estimated
Mean Annual Wind Speed:	U _m =	2.91 m/sec	USEPA 1996
Threshold Wind Speed:	U _t =	11.32 m/sec	USEPA 1996
Function x	x =	3.45	calculated
Erosion Function:	F(x) =	0.00046	USEPA 1996
Conversion Factor:	CF _{time} =	3600 sec/hour	
Particulate Emission Factor:	PEF =	1.41E+12 m ³ /kg	

TABLE 5-7
PARTICULATE EMISSION MODELING: EXCAVATION SCENARIO

articulate Emissions due to Wind Erosion

Respirable fraction:	0.036	
Fraction of vegetative cover:	0%	
Mean annual wind speed:	2.91	m/sec
Threshold wind speed (7m):	11.3	m/sec
X for Erosion function:	3.441	
Erosion function:	0.00045	
Conversion factor - time:	2.78E-04	hr/sec
Site area:	10000	m ²
Particulate Emission Rate:	7.68E-11	g/m ² -sec

Source

USEPA 1996
estimated
USEPA 1996
USEPA 1996
calculated

estimated

Particulate Emissions due to Vehicle Disturbance

Emission Scenario	Silt Content (%)	Speed (kph)	Mean Vehicle Weight (Mg)	Mean Vehicle Wheels	Number of Wet Days	E10 (kg/VKT)
Source	RAEPESCS(1984)	estimated	estimated	estimated	RAEPESCS(1984)	calculated
4-Wheel Light Duty	29	24	3	4	120	0.79
6-Wheel Sludge Trucks	29	24	20	6	120	2.28
Tracked LGP	29	8	20	6	120	0.95
Tracked Backhoes	29	8	20	6	120	0.95

Source	Round Trips / Month	Vehicles / Round Trip	Ft / Vehicle	Mile / Ft	Month / Year	Km / Mile	VKT/Year
	estimated	estimated	estimated				calculated
4-Wheel Light Duty	100	4	300	0.0002	12	1.60	438
6-Wheel Sludge Trucks	100	2	300	0.0002	12	1.60	219
Tracked LGP	100	2	300	0.0002	12	1.60	219
Tracked Backhoes	100	2	300	0.0002	12	1.60	219

Emission Scenario	E10 (kg/VKT)	A (VKT/year)	E10*A (g/sec)	Control Efficiency (%)	E (g/sec)
Source	calculated	calculated			
4-Wheel Light Duty	0.79	438	1.10E-02	0%	1.10E-02
6-Wheel Sludge Trucks	2.28	219	1.58E-02	0%	1.58E-02
Tracked LGP	0.95	219	6.56E-03	0%	6.56E-03
Tracked Backhoes	0.95	219	6.56E-03	0%	6.56E-03

Particulate Emission Rate: 0.0399

articulate Emissions due to Material Handling/Earthmoving

particle size multiplier	0.35	
mean wind speed	2.91	m/s
moisture content	15	%
soil bulk density	1.5	g/cm ³
mass of soil handled	150000	Mg
volume of soil moved	100000	m ³
area of soil moved	10000	m ²
Exposure time	261	day
PM (10) emission rate	3.19E-08	g/m ² -sec

Source

TSDF
USEPA (1996)
USEPA (1996)
USEPA (1996)
estimated
estimated
estimated
estimated

Total Particulate Emissions

Wind Erosion Emission Rate:	7.68E-11	g/m ² -sec
Source area (S1):	10000	m ²
Vehicle Traffic Emission Rate:	0.04	g/sec
Vehicle Traffic Emission Rate (S1):	3.99E-06	g/m ² -sec
Material Transfer Emission Rate (S2):	3.19E-08	g/m ² -sec
Total Particulate Emission Rate (S1):	4.02E-06	g/m ² -sec
Additive PM(10) emissions	4.02E-06	g/m ² - sec
AREA	2.471	acres
Q/C	41.83	g/m ² -sec per kg/m ³
PEF	1.04E+07	m ³ /kg

USEPA (1996) : Soil Screening Guidance: User's Guide

RAEPESCS(1984): Rapid Assessment of Exposure to Particulate emission from Surface Contamination Sites

TSDF(1989): Hazardous Waste TSDF - Fugitive Particulate Matter Air Emissions Guidance Document

TABLE 5-8
BAM PARAMETERS (VOLATILIZATION FROM SOIL)

Site Parameters

Rhob: soil bulk density (g/cm ³)	Source	Pt: soil porosity (cm ³ /cm ³)	Source
value: 1.50E+00	USEPA (1996)	value: 4.30E-01	USEPA (1996)
Pw: volumetric water content (cm ³ /cm ³)		Pa: air porosity (cm ³ /cm ³)	
value: 1.50E-01	USEPA (1996)	value: 2.80E-01	USEPA (1996)
Dair: air diffusion coefficient (cm ² /s)		RT: gas constant times temp. (m ³ -atm/mol)	
value: 8.70E-02	Jury et al (1983)	value: 2.45E-02	calculated
foc: fraction organic carbon		Jw: net water flux (cm/s)	
value: 6.00E-03	USEPA (1996)	value: 0.00E+00	estimated
Rhow: density of water (g/cm ³)		RH: relative humidity	
value: 1.00E+00	Jury et al (1983)	value: 5.00E-01	Jury et al (1983)
Gl: gravimetric water content (g/g)		Rhowv: density of sat. water vapor (g/cm ³)	
value: 1.00E-01	calculated	value: 1.73E-05	calculated
Tortl: tortuosity factor for liquids		Tortg: tortuosity factor for gases	
value: 9.76E-03	calculated	value: 7.77E-02	calculated
Dwv: water vapor diffusion coefficient (cm ³ /cm-s)		T: absolute soil temperature (K)	
value: 2.30E-01	calculated	value: 2.98E+02	estimated
		E: Evaporation ra -0.00000289	estimated

Chemical	Koc (ml/g)	Kh	Kd (ml/g)	Dair (cm ³ /cm-s)	Dg (cm ³ /cm-s)	Dwater (cm ³ /cm-s)	Dl (cm ³ /cm-s)	Rg (cm ³ /cm ³)
Benzene	5.89E+01	2.28E-01	3.53E-01	8.80E-02	6.84E-03	9.80E-06	9.56E-08	3.26E+00
Trichloroethene	1.66E+02	4.22E-01	9.96E-01	7.90E-02	6.14E-03	7.03E-06	6.86E-08	4.18E+00
Vinyl Chloride	1.86E+01	1.10E+00	1.12E-01	1.06E-01	8.23E-03	1.23E-06	1.20E-08	5.67E-01

Chemical	Rl (cm ³ /cm ³)	d (cm)	Ve (cm/s)	De (cm ² /s)	He (cm/s)	[Soil] mg/kg	Cto (mg/cm ³)	Depth(z2) feet
Benzene	7.44E-01	3.44E-01	0.00E+00	2.09E-03	7.84E-02	3.0E-02	4.95E-05	30
Trichloroethene	1.76E+00	3.44E-01	0.00E+00	1.47E-03	5.49E-02	1.3E+00	2.15E-03	22
Vinyl Chloride	6.27E-01	3.44E-01	0.00E+00	1.45E-02	5.43E-01	1.2E-02	1.98E-05	22

USEPA (1996) : Soil Screening Guidance: User's Guide

TABLE 5-9
TIME AVERAGED FLUX RATES FROM BAM (VOLATILIZATION FROM SOIL)

Chemical	Exposure Period				
	4.2 YEAR	6 YEAR	9 YEAR	25 YEAR	30 YEAR
Operable Unit 1	g/m2-sec	g/m2-sec	g/m2-sec	g/m2-sec	g/m2-sec
Trichloroethene	6.61E-08	5.05E-08	3.65E-08	1.51E-08	1.28E-08
Vinyl Chloride	8.64E-10	6.19E-10	4.22E-10	1.58E-10	1.32E-10
Operable Unit 2					
Benzene	1.92E-09	1.49E-09	1.09E-09	4.60E-10	3.91E-10

TABLE 5-10
ISCST3 SOURCE PARAMETERS

Location	Source Location		Area (m2)	Angle of Rotaion (degrees)
	SW x	SW y		
OU1 - 1	300	750	105000	0
OU1 - 2	500	1100	40000	0
OU1 - 3	600	1350	87500	0
OU1 - 4	700	2000	67500	0
OU1 - 5	850	1850	357500	0
OU1 - 6	1000	1500	140000	0
OU1 - 7		1400	20000	0
OU1 - 8	1000	1250	45000	0
OU1 - 9	1000	1000	30000	0
OU1 - 10	1000	750	25000	0
OU2 - 1	300	400	105000	0
OU2 - 2	600	300	30000	0
OU2 - 3	700	150	30000	0
OU2 - 4	900	300	30000	0
OU2 - 5	950	600	22500	0

TABLE 5-11
BAM PARAMETERS (VOLATILIZATION FROM GROUND WATER): OPERABLE UNIT 1

Site Parameters

Rhob: soil bulk density (g/cm ³)	Source	Pt: soil porosity (cm ³ /cm ³)	Source
value: 1.50E+00	USEPA (1996)	value: 4.30E-01	USEPA (1996)
Pw: volumetric water content (cm ³ /cm ³)		Pa: air porosity (cm ³ /cm ³)	
value: 1.50E-01	USEPA (1996)	value: 2.80E-01	USEPA (1996)
Dair: air diffusion coefficient (cm ² /s)		RT: gas constant times temp. (m ³ -atm/mol)	
value: 8.70E-02	Jury et al (1983)	value: 2.45E-02	calculated
foc: fraction organic carbon		Jw: net water flux (cm/s)	
value: 6.00E-03	USEPA (1996)	value: 0.00E+00	estimated
Rhow: density of water (g/cm ³)		RH: relative humidity	
value: 1.00E+00	Jury et al (1983)	value: 5.00E-01	Jury et al (1983)
GI: gravimetric water content (g/g)		Rhowv: density of sat. water vapor (g/cm ³)	
value: 1.00E-01	calculated	value: 1.73E-05	calculated
Tortl: tortuosity factor for liquids		Tortg: tortuosity factor for gases	
value: 9.76E-03	calculated	value: 7.77E-02	calculated
Dwv: water vapor diffusion coefficient (cm ³ /cm-s)		T: absolute soil temperature (K)	
value: 2.30E-01	calculated	value: 2.98E+02	estimated
		E: Evaporation rate	-0.00000289 estimated

Chemical	Hc (atm-m ³ /mol)	Koc (ml/g)	Kh	Kd (ml/g)	Dair (cm ³ /cm-s)	Dg (cm ³ /cm-s)	Dwater (cm ³ /cm-s)
Benzene	5.6E-03	58.9	2.3E-01	3.5E-01	8.8E-02	6.8E-03	9.8E-06
1,2-Dichloroethane	9.8E-04	17.4	4.0E-02	1.0E-01	1.0E-01	8.1E-03	9.9E-06
1,1-Dichloroethane	2.6E-02	58.9	1.1E+00	3.5E-01	9.0E-02	7.0E-03	1.0E-05
1,2 DCE	6.7E-03	44.0	2.7E-01	2.6E-01	7.2E-02	5.6E-03	1.2E-05
Cis. 1,2 Dichloroethene	4.1E-03	35.5	1.7E-01	2.1E-01	7.4E-02	5.7E-03	1.1E-05
Methylnaphthalene, 2	5.8E-05	2943	2.4E-03	1.8E+01	6.3E-02	4.9E-03	9.0E-06
N-Nitrosodiphenylamine	5.0E-06	1290	2.0E-04	7.7E+00	3.1E-02	2.4E-03	6.4E-06
Napthalene	4.8E-04	2000	2.0E-02	1.2E+01	5.9E-02	4.6E-03	7.5E-06
Tetrachloroethylene	1.8E-02	155	7.5E-01	9.3E-01	7.2E-02	5.6E-03	8.2E-06
1,1,1-Trichloroethane	1.7E-02	110	7.0E-01	6.6E-01	7.8E-02	6.1E-03	8.8E-06
1,1,2 Trichloroethane	9.1E-04	50.1	3.7E-02	3.0E-01	7.8E-02	6.1E-03	8.8E-06
Trichloroethylene	1.0E-02	166	4.2E-01	1.0E+00	7.9E-02	6.1E-03	9.1E-06
Vinyl chloride	2.7E-02	18.9	1.1E+00	1.1E-01	1.1E-01	8.2E-03	1.2E-06
Vinyl Acetate	5.1E-04	5.3	2.1E-02	3.2E-02	8.5E-02	6.6E-03	9.2E-06

Chemical	Dl (cm ³ /cm-s)	Rg (cm ³ /cm ³)	Rl (cm ³ /cm ³)	d (cm)	Ve (cm/s)	De (cm ² /s)	He (cm/s)
Benzene	9.6E-08	3.3E+00	7.4E-01	3.4E-01	0.0E+00	2.1E-03	7.8E-02
1,2-Dichloroethane	9.7E-08	7.9E+00	3.2E-01	3.4E-01	0.0E+00	1.0E-03	3.8E-02
1,1-Dichloroethane	1.0E-07	9.2E-01	9.8E-01	3.4E-01	0.0E+00	7.6E-03	2.8E-01
1,2 DCE	1.1E-07	2.3E+00	6.2E-01	3.4E-01	0.0E+00	2.5E-03	9.3E-02
Cis. 1,2 Dichloroethene	1.1E-07	3.1E+00	5.2E-01	3.4E-01	0.0E+00	1.8E-03	6.9E-02
Methylnaphthalene, 2	8.8E-08	1.1E+04	2.7E+01	3.4E-01	0.0E+00	4.4E-07	1.6E-05
N-Nitrosodiphenylamine	6.2E-08	5.8E+04	1.2E+01	3.4E-01	0.0E+00	4.7E-08	1.6E-06
Napthalene	7.3E-08	9.2E+02	1.8E+01	3.4E-01	0.0E+00	5.0E-06	1.9E-04
Tetrachloroethylene	8.0E-08	2.3E+00	1.8E+00	3.4E-01	0.0E+00	2.4E-03	9.0E-02
1,1,1-Trichloroethane	8.6E-08	1.9E+00	1.3E+00	3.4E-01	0.0E+00	3.2E-03	1.2E-01
1,1,2 Trichloroethane	8.6E-08	1.6E+01	6.1E-01	3.4E-01	0.0E+00	3.7E-04	1.4E-02
Trichloroethylene	8.9E-08	4.2E+00	1.8E+00	3.4E-01	0.0E+00	1.5E-03	5.5E-02
Vinyl chloride	1.2E-08	5.7E-01	6.3E-01	3.4E-01	0.0E+00	1.4E-02	5.4E-01
Vinyl Acetate	9.0E-08	9.7E+00	2.0E-01	3.4E-01	0.0E+00	6.8E-04	2.5E-02

USEPA (1996) : Soil Screening Guidance: User's Guide

TABLE 5-12
BAM PARAMETERS (VOLATILIZATION FROM GROUND WATER): OPERABLE UNIT 2

Site Parameters

Rhob: soil bulk density (g/cm ³)	Source	Pt: soil porosity (cm ³ /cm ³)	Source
value: 1.50E+00	USEPA (1996)	value: 4.30E-01	USEPA (1996)
Pw: volumetric water content (cm ³ /cm ³)		Pa: air porosity (cm ³ /cm ³)	
value: 1.50E-01	USEPA (1996)	value: 2.80E-01	USEPA (1996)
Dair: air diffusion coefficient (cm ² /s)		RT: gas constant times temp. (m ³ -atm/mol)	
value: 8.70E-02	Jury et al (1983)	value: 2.45E-02	calculated
foc: fraction organic carbon		Jw: net water flux (cm/s)	
value: 6.00E-03	USEPA (1996)	value: 0.00E+00	estimated
Rhow: density of water (g/cm ³)		RH: relative humidity	
value: 1.00E+00	Jury et al (1983)	value: 5.00E-01	Jury et al (1983)
GI: gravimetric water content (g/g)		Rhowv: density of sat. water vapor (g/cm ³)	
value: 1.00E-01	calculated	value: 1.73E-05	calculated
Tortl: tortuosity factor for liquids		Tortg: tortuosity factor for gases	
value: 9.76E-03	calculated	value: 7.77E-02	calculated
Dwv: water vapor diffusion coefficient (cm ³ /cm-s)		T: absolute soil temperature (K)	
value: 2.30E-01	calculated	value: 2.98E+02	estimated
		E: Evaporation rate	-0.00000289 estimated

Chemical	Hc (atm-m ³ /mol)	Koc (ml/g)	Kh	Kd (ml/g)	Dair (cm ³ /cm-s)	Dg (cm ³ /cm-s)	Dwater (cm ³ /cm-s)
Benzene	5.6E-03	58.9	2.3E-01	3.5E-01	8.8E-02	6.8E-03	9.8E-06
Dibenzofuran	9.8E-04	4675	4.0E-02	2.8E+01	5.9E-02	4.6E-03	6.7E-06
1,2-Dichloroethane	9.8E-04	17.4	4.0E-02	1.0E-01	1.0E-01	8.1E-03	9.9E-06
1,1-Dichloroethene	2.6E-02	58.9	1.1E+00	3.5E-01	9.0E-02	7.0E-03	1.0E-05
Cis. 1,2 Dichloroethene	4.1E-03	35.5	1.7E-01	2.1E-01	7.4E-02	5.7E-03	1.1E-05
Fluorene	6.4E-05	13800	2.6E-03	8.3E+01	3.6E-02	2.8E-03	7.9E-06
Methylene chloride	2.2E-03	11.7	8.9E-02	7.0E-02	1.0E-01	7.8E-03	1.2E-05
Methylnaphthalene, 2	5.8E-05	2943	2.4E-03	1.8E+01	6.3E-02	4.9E-03	9.0E-06
Napthalene	4.8E-04	2000	2.0E-02	1.2E+01	5.9E-02	4.6E-03	7.5E-06
Phenanthrene	3.9E-05	14000	1.6E-03	8.4E+01	5.5E-02	4.3E-03	6.2E-06
Tetrachloroethylene	1.8E-02	155	7.5E-01	9.3E-01	7.2E-02	5.6E-03	8.2E-06
1,1,1-Trichloroethane	1.7E-02	110	7.0E-01	6.6E-01	7.8E-02	6.1E-03	8.8E-06
Trichloroethylene	1.0E-02	166	4.2E-01	1.0E+00	7.9E-02	6.1E-03	9.1E-06
Vinyl chloride	2.7E-02	18.9	1.1E+00	1.1E-01	1.1E-01	8.2E-03	1.2E-06

Chemical	DI (cm ³ /cm-s)	Rg (cm ³ /cm ³)	RI (cm ³ /cm ³)	d (cm)	Ve (cm/s)	De (cm ² /s)	He (cm/s)
Benzene	9.6E-08	3.3E+00	7.4E-01	3.4E-01	0.0E+00	2.1E-03	7.8E-02
Dibenzofuran	6.5E-08	1.1E+03	4.2E+01	3.4E-01	0.0E+00	4.3E-06	1.6E-04
1,2-Dichloroethane	9.7E-08	7.9E+00	3.2E-01	3.4E-01	0.0E+00	1.0E-03	3.8E-02
1,1-Dichloroethene	1.0E-07	9.2E-01	9.8E-01	3.4E-01	0.0E+00	7.6E-03	2.8E-01
Cis. 1,2 Dichloroethene	1.1E-07	3.1E+00	5.2E-01	3.4E-01	0.0E+00	1.8E-03	6.9E-02
Fluorene	7.7E-08	4.8E+04	1.2E+02	3.4E-01	0.0E+00	6.0E-08	2.2E-06
Methylene chloride	1.1E-07	3.1E+00	2.8E-01	3.4E-01	0.0E+00	2.5E-03	9.4E-02
Methylnaphthalene, 2	8.8E-08	1.1E+04	2.7E+01	3.4E-01	0.0E+00	4.4E-07	1.6E-05
Napthalene	7.3E-08	9.2E+02	1.8E+01	3.4E-01	0.0E+00	5.0E-06	1.9E-04
Phenanthrene	6.0E-08	7.9E+04	1.3E+02	3.4E-01	0.0E+00	5.4E-08	2.0E-06
Tetrachloroethylene	8.0E-08	2.3E+00	1.8E+00	3.4E-01	0.0E+00	2.4E-03	9.0E-02
1,1,1-Trichloroethane	8.6E-08	1.9E+00	1.3E+00	3.4E-01	0.0E+00	3.2E-03	1.2E-01
Trichloroethylene	8.9E-08	4.2E+00	1.8E+00	3.4E-01	0.0E+00	1.5E-03	5.5E-02
Vinyl chloride	1.2E-08	5.7E-01	6.3E-01	3.4E-01	0.0E+00	1.4E-02	5.4E-01

USEPA (1996) : Soil Screening Guidance: User's Guide

TABLE 5-13
TIME AVERAGED FLUX RATES FROM BAM (VOLATILIZATION FROM GROUND WATER)

OU - 1			OU - 2		
	4.2 y	25 y		4.2 y	25 y
Chemical	mg/cm2/sec	mg/cm2/sec	Chemical	mg/cm2/sec	mg/cm2/sec
Benzene	1.1E-09	1.1E-09	Benzene	4.57E-10	4.60E-10
Dichloroethane, 1,2-	9.9E-10	1.0E-09	Dibenzofuran	0.00E+00	3.33E-12
Dichloroethene, 1,1-	3.8E-09	3.8E-09	Dichloroethane, 1,2-	5.75E-10	5.83E-10
Dichloroethene, 1,2-	9.0E-09	9.0E-09	Dichloroethene, 1,1-	1.06E-08	1.06E-08
Dichloroethene, Cis-1,2-	3.2E-09	3.3E-09	Dichloroethene, Cis-1,2-	1.21E-08	1.22E-08
N-Nitrosodiphenylamine	0.0E+00	0.0E+00	Fluorene	0.00E+00	0.00E+00
Tetrachloroethene	4.1E-09	4.1E-09	Methylene Chloride	1.95E-09	1.96E-09
Trichloroethane, 1,1,1-	1.6E-07	1.6E-07	Methylnaphthalene, 2-	0.00E+00	0.00E+00
Trichloroethane, 1,1,2-	3.3E-10	3.4E-10	Naphthalene	0.00E+00	4.17E-11
Trichloroethene	2.3E-08	2.3E-08	Phenanthrene	0.00E+00	0.00E+00
Vinyl Chloride	7.0E-09	7.0E-09	Tetrachloroethene	1.94E-09	1.95E-09
Vinyl Acetate	1.9E-09	1.9E-09	Trichloroethane, 1,1,1-	4.70E-08	4.73E-08
			Trichloroethene	5.11E-08	5.17E-08
			Vinyl Chloride	7.32E-09	7.33E-09

TABLE 5-14
INDOOR AIR CONCENTRATION MODEL PARAMETERS

Box Length Lb =	300	cm
Box Width Wb =	500	cm
Box Height Hb =	300	cm
Box volume, Vb =	4.5E+07	cm3
Base area of the box, Ab =	1.5E+05	cm2
Ventilation rate, Vr =	2.8E-04	changes/sec
Attenuation factor for flooring, Fcrack =	0.001	%

TABLE 5-15
SUMMARY OF EPCs FOR OPERABLE UNIT 1
GEAE EVENDALE
(Page 1 of 1)

Chemical	Ambient Air (mg/m3)		Indoor Air (mg/m3)		Perched Groundwater (mg/L)		Sediment (mg/kg)		Surface Soil (mg/kg)		Total Soil (mg/kg)	
	MLE	RME	MLE	RME	MLE	RME	MLE	RME	MLE	RME	MLE	RME
Aroclor-1242					2.0E-04	7.2E-04						
Aroclor-1248					3.4E-03	2.6E-02			7.1E+01	3.9E+02	2.6E+00	4.9E+00
Aroclor-1254											8.4E-01	1.1E+00
Aroclor-1260											7.7E-01	1.0E+00
Arsenic					1.0E-02	7.6E-02						
Benzene	6.6E-06	1.6E-06	2.0E-05	2.0E-05	6.9E-03	1.0E-02	2.1E+02	8.2E+02				
Benzo(a)Anthracene											4.5E-01	4.9E-01
Benzo(a)Pyrene									3.6E-01	3.6E-01	4.0E-01	4.4E-01
Benzo(b)Fluoranthene											5.7E-01	6.1E-01
Bis(2-Ethylhexyl)Phthalate					9.2E-02	5.3E-01						
Chromium					1.0E-01	1.3E+00						
Dichloroethane, 1,2-			1.2E-05	1.2E-05	1.2E-02	1.2E-02						
Dichloroethene, 1,1-			6.5E-05	6.5E-05	6.1E-03	8.7E-03						
Dichloroethene, 1,2-			2.2E-04	2.2E-04	4.4E-02	8.8E-02						
Dichloroethene, Cis-1,2-			1.1E-04	1.1E-04	2.2E-02	6.3E-02						
Ethylbenzene							2.1E+02	8.4E+02				
Manganese									1.5E+04	4.9E+04	2.0E+03	3.2E+03
Nickel					6.8E-02	7.9E-01					5.3E+01	8.2E+01
N-Nitrosodiphenylamine					6.2E-03	7.9E-03						
Tetrachloroethene			4.9E-05	5.0E-05	2.1E-02	2.1E-02						
Toluene							9.5E+02	3.8E+03				
Total Petroleum Hydrocarbons					5.6E+01	2.2E+02			6.5E+03	4.6E+04	1.2E+03	1.2E+03
Trichloroethane, 1,1,1-			3.1E-03	3.2E-03	6.1E-01	1.0E+00						
Trichloroethane, 1,1,2-			3.9E-06	4.1E-06	1.1E-02	1.1E-02						
Trichloroethene	5.5E-03	1.3E-03	5.4E-04	5.5E-04	1.9E-01	3.7E-01			6.8E-01	4.2E+00	1.3E+00	1.4E+01
Vinyl Acetate			4.4E-05	4.5E-05	3.3E-02	6.5E-02						
Vinyl Chloride	7.2E-05	1.3E-05	8.9E-05	8.9E-05	5.9E-03	6.3E-03					1.2E-02	1.5E-02
Xylenes							1.6E+03	6.2E+03				

TABLE 5-16
SUMMARY OF EPCs FOR OPERABLE UNIT 2
GEAE EVENDALE
(Page 1 of 1)

Chemical	Ambient Air (mg/m3)		Indoor Air (mg/m3)		Perched Groundwater (mg/L)		Sediment (mg/kg)		Surface Soil (mg/kg)		Total Soil (mg/kg)	
	MLE	RME	MLE	RME	MLE	RME	MLE	RME	MLE	RME	MLE	RME
Benzene	4.9E-05	1.2E-05	6.5E-06	6.5E-06	2.8E-03	3.3E-03	4.9E+00	3.0E+01			3.0E-02	5.6E-02
Bis(2-Ethylhexyl)Phthalate					1.0E-02	1.0E-02						
Cadmium					2.8E-03	3.4E-03						
Chromium					5.9E-02	3.4E-01						
Dibenzofuran				4.0E-08	2.6E-02	3.0E-02						
Dichloroethane, 1,2-			6.9E-06	7.0E-06	7.0E-03	7.0E-03						
Dichloroethene, 1,1-			2.4E-04	2.4E-04	1.7E-02	3.2E-02						
Dichloroethene, Cis-1,2-			4.2E-04	4.3E-04	8.2E-02	2.4E-01						
Fluorene					4.4E-02	4.8E-02						
Lead							4.2E+02	1.1E+03				
Manganese							1.4E+03	3.2E+03				
Methylene Chloride			5.7E-05	5.7E-05	9.5E-03	2.3E-02						
Methylnaphthalene, 2-					7.9E-01	1.4E+00						
Naphthalene				5.4E-07	2.2E-01	2.4E-01						
Nickel					1.1E-01	8.3E-01						
Phenanthrene					9.8E-02	1.0E-01						
Tetrachloroethene			5.9E-05	5.9E-05	9.9E-03	2.5E-02						
Total Petroleum Hydrocarbons					8.5E+04	1.7E+05			4.0E+02	2.5E+03	9.4E+02	8.0E+03
Trichloroethane, 1,1,1-			2.9E-03	2.9E-03	1.8E-01	9.1E-01						
Trichloroethene	1.1E-03	2.6E-04	3.2E-03	3.2E-03	4.2E-01	2.2E+00						
Vinyl Chloride	1.5E-05	2.7E-06	1.1E-04	1.1E-04	6.2E-03	7.9E-03						
Xylenes							3.0E+01	5.8E+02				

TABLE 5-17
SUMMARY OF EPCs FOR OPERABLE UNIT 3
GEAE EVENDALE
(Page 1 of 1)

Chemical	Ambient Air (mg/m3)	
	MLE	RME
Benzene	3.1E-06	1.1E-06
Trichloroethene	1.3E-03	4.6E-04
Vinyl Chloride	1.5E-05	4.7E-06

TABLE 5-18
SUMMARY OF EPCs FOR OPERABLE UNIT 4
GEAE EVENDALE
(Page 1 of 1)

Chemical	Ambient Air (mg/m3)		Surface Soil (mg/kg)	
	MLE	RME	MLE	RME
Arsenic			6.7E+01	2.3E+02
Benzene	2.1E-05	5.0E-06		
Lead			1.0E+03	3.5E+03
Trichloroethene	2.8E-03	6.4E-04		
Vinyl Chloride	3.7E-05	6.7E-06		

TABLE 5-19
SUMMARY OF EXPOSURE PARAMETER VALUES
GEAE EVENDALE
(Page 1 of 1)

Parameter	<u>Resident^f</u>		<u>General Worker</u>		<u>Excavation Worker</u>		<u>Indoor Worker</u>	
	MLE	RME	MLE	RME	MLE	RME	MLE	RME
BW (kg)	70 ^b	70 ^b	70 ^b	70 ^b	70 ^b	70 ^b	70 ^b	70 ^b
Averaging time, cancer (days)	25,550 ^c	25,550 ^c	25,550 ^c	25,550 ^c	25,550 ^c	25,550 ^c	25,550 ^c	25,550 ^c
Averaging time, noncancer (days)	3,285 ^b	10,950 ^b	1,533 ^b	9,125 ^b	365 ^d	365 ^d	1,533 ^b	9,125 ^b
Exposure time at/near site (hr/day)	24 ^d	24 ^d	8 ^d	8 ^d	8 ^d	8 ^d	8 ^d	8 ^d
Exposure time for direct contact with groundwater (hr)	NA	NA	NA	NA	0.5	1	NA	NA
Exposure frequency (d/y)	350 ^c	350 ^c	250 ^c	250 ^c	5 ^d	20 ^d	250 ^c	250 ^c
Exposure duration, (y)	9 ^c	30 ^c	4.2 ^b	25 ^b	1 ^d	1 ^d	4.2 ^b	25 ^b
Soil ingestion (mg/d)	NA	NA	10 ^d	50 ^c	10 ^d	50 ^c	NA	NA
Inhalation rate (m3/d)	15 ^a	20 ^c	15 ^a	20 ^c	15 ^a	20 ^c	15 ^a	20 ^c
Soil-skin adherence factor (mg/cm2)	NA	NA	0.2 ^c	1.0 ^c	0.2 ^c	1.0 ^c	NA	NA
Total skin surface area (cm2)	NA	NA	18,150 ^b	18,150 ^b	18,150 ^b	18,150 ^b	NA	NA
Fraction of skin exposed to soil/sediment and groundwater	NA	NA	0.125 ^c	0.25 ^c	0.125 ^c	0.25 ^c	NA	NA
Particulate emission factor (m3/kg)	NA	NA	1.4E+12 ^a	1.4E+12 ^a	1.0E+07 ^a	1.0E+07 ^a	NA	NA

a calculated.

b EFH, USEPA (1989b).

c RAGS, USEPA (1989a).

d based on professional judgement.

e DEAPA, USEPA (1992a).

f Parameters also apply to resident farmer

g EFH, USEPA (1990)

NA Not applicable

TABLE 5-20
DERIVATION OF AGE-ADJUSTED INTAKES
FOR RESIDENT ADULT SCENARIO
GEAE EVENDALE
(Page 1 of 1)

$$\text{Age-Adjusted Intake} = \text{ED1} \times \text{IR1/BW1} + \text{ED2} \times \text{IR2/BW2}$$

Parameter	MLE Intakes			RME Intakes			Units
	Child	Youth	9-yr	Child	Adult	30-yr	
			age-adjusted factor			age-adjusted factor	
Exposure Duration (ED, yr)	6	3	--	6	24	--	
Body Weight (BW, kg)	15	36	--	15	70	--	
Inhalation Rate (IR, m ³ /d)	15	15	7.25	20	20	14.9	m ³ -yr/kg-d

ED = exposure duration for age group under consideration

W = body weight for age group under consideration

. = media-specific intake rate for age group under consideration

TABLE 5-21
OPERABLE UNIT 1:
SUMMARY OF ADDs FOR A GENERAL WORKER
GEAE EVENDALE
(Page 1 of 1)

	Ambient Air		Surface Soil		Chemical-Specific
Chemical	Inhalation	Oral	Inhalation	Dermal	Subtotal
MLE ADDs (mg/kg-day)					
Aroclor-1248		7.1E-06	2.6E-12	1.9E-05	2.7E-05
Benzene	3.2E-07				3.2E-07
Benzo(a)Pyrene		3.5E-08	1.3E-14	1.6E-07	2.0E-07
Manganese		1.4E-03	5.0E-10	NA	1.4E-03
Total Petroleum Hydrocarbons		6.6E-04	2.4E-10	7.5E-03	8.2E-03
Trichloroethene	2.7E-04	6.9E-08	2.5E-14	7.8E-07	2.7E-04
Vinyl Chloride	3.5E-06				3.5E-06
Pathway-Specific Subtotal	2.7E-04	2.1E-03	7.4E-10	7.6E-03	1E-02
% of Total	2.7%	21.0%	0.0%	76.3%	100.0%
RME ADDs (mg/kg-day)					
Aroclor-1248		1.9E-04	1.8E-11	1.0E-03	1.2E-03
Benzene	1.0E-07				1.0E-07
Benzo(a)Pyrene		1.8E-07	1.7E-14	1.6E-06	1.8E-06
Manganese		2.4E-02	2.3E-09	NA	2.4E-02
Total Petroleum Hydrocarbons		2.3E-02	2.1E-09	5.1E-01	5.3E-01
Trichloroethene	8.2E-05	3.4E-06	3.2E-13	7.7E-05	1.6E-04
Vinyl Chloride	8.5E-07				8.5E-07
Pathway-Specific Subtotal	8.3E-05	4.7E-02	4.4E-09	5.1E-01	6E-01
% of Total	0.0%	8.4%	0.0%	91.6%	100.0%

NA Not applicable.

TABLE 5-22
OPERABLE UNIT 1:
SUMMARY OF LADDs FOR A GENERAL WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Ambient Air		Surface Soil		Chemical-Specific Subtotal
	Inhalation	Oral	Inhalation	Dermal	
MLE LADDs (mg/kg-day)					
Aroclor-1248		4.3E-07	1.5E-13	1.2E-06	1.6E-06
Benzene	1.9E-08				1.9E-08
Benzo(a)Pyrene		2.1E-09	7.5E-16	9.6E-09	1.2E-08
Manganese		8.4E-05	3.0E-11	NA	8.4E-05
Total Petroleum Hydrocarbons		4.0E-05	1.4E-11	4.5E-04	4.9E-04
Trichloroethene	1.6E-05	4.1E-09	1.5E-15	4.7E-08	1.6E-05
Vinyl Chloride	2.1E-07				2.1E-07
Pathway-Specific Subtotal	1.6E-05	1.2E-04	4.5E-11	4.5E-04	6E-04
% of Total	2.7%	21.0%	0.0%	76.3%	100.0%
RME LADDs (mg/kg-day)					
Aroclor-1248		6.8E-05	6.5E-12	3.7E-04	4.4E-04
Benzene	3.7E-08				3.7E-08
Benzo(a)Pyrene		6.3E-08	6.0E-15	5.7E-07	6.3E-07
Manganese		8.6E-03	8.2E-10	NA	8.6E-03
Total Petroleum Hydrocarbons		8.0E-03	7.7E-10	1.8E-01	1.9E-01
Trichloroethene	2.9E-05	1.2E-06	1.2E-13	2.7E-05	5.8E-05
Vinyl Chloride	3.0E-07				3.0E-07
Pathway-Specific Subtotal	2.9E-05	1.7E-02	1.6E-09	1.8E-01	2E-01
% of Total	0.0%	8.4%	0.0%	91.6%	100.0%

NA Not applicable.

TABLE 5-23
OPERABLE UNIT 1:
SUMMARY OF ADDs FOR AN EXCAVATION WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Perched Groundwater		Total Soil		Sediment		Chemical-Specific
	Dermal	Oral	Inhalation	Dermal	Oral	Dermal	Subtotal
	MLE ADDs (mg/kg-day)						
Aroclor-1242	1.8E-09						1.8E-09
Aroclor-1248	5.5E-07	5.2E-09	2.5E-10	1.4E-08			5.6E-07
Aroclor-1254		1.7E-09	7.9E-11	4.5E-09			6.2E-09
Aroclor-1260		1.5E-09	7.3E-11	4.1E-09			5.7E-09
Arsenic	2.3E-09						2.3E-09
Benzene	1.7E-07				4.0E-07	4.6E-06	5.1E-06
Benzo(a)Anthracene		8.8E-10	4.2E-11	4.0E-09			4.9E-09
Benzo(a)Pyrene		7.8E-10	3.7E-11	3.5E-09			4.3E-09
Benzo(b)Fluoranthene		1.1E-09	5.4E-11	5.1E-09			6.2E-09
Bis(2-Ethylhexyl)Phthalate	6.8E-07						6.8E-07
Chromium	2.3E-08						2.3E-08
Dichloroethane, 1,2-	1.4E-08						1.4E-08
Dichloroethene, 1,1-	2.2E-08						2.2E-08
Dichloroethene, 1,2-	9.9E-08						9.9E-08
Dichloroethene, Cis-1,2-	4.9E-08						4.9E-08
Ethylbenzene					4.1E-07	4.7E-06	5.1E-06
Manganese		3.9E-06	1.9E-07	NA			4.0E-06
N-Nitrosodiphenylamine	2.8E-08						2.8E-08
Nickel	1.5E-08	1.0E-07	5.0E-09	4.7E-08			1.7E-07
Tetrachloroethene	1.7E-06						1.7E-06
Toluene					1.9E-06	2.1E-05	2.3E-05
Total Petroleum Hydrocarbons	8.5E-04	2.3E-06	1.1E-07	2.6E-05			8.8E-04
Trichloroethane, 1,1,1-	2.3E-06						2.3E-06
Trichloroethane, 1,1,2-	2.1E-08						2.1E-08
Trichloroethene	9.9E-06	2.5E-09	1.2E-10	2.8E-08			9.9E-06
Vinyl Acetate	1.4E-08						1.4E-08
Vinyl Chloride	9.6E-09	2.4E-11	1.1E-12	2.7E-10			9.9E-09
Xylenes					3.0E-06	3.4E-05	3.7E-05
Pathway-Specific Subtotal	8.7E-04	6.3E-06	3.0E-07	2.6E-05	5.7E-06	6.5E-05	1E-03
% of Total	89.4%	0.6%	0.0%	2.7%	0.6%	6.7%	100.0%
Chemical	RME ADDs (mg/kg-day)						
	Dermal	Oral	Inhalation	Dermal	Oral	Dermal	
	RME ADDs (mg/kg-day)						
Aroclor-1242	1.0E-07						1.0E-07
Aroclor-1248	6.7E-05	1.9E-07	2.4E-09	1.0E-06			6.8E-05
Aroclor-1254		4.5E-08	5.8E-10	2.4E-07			2.9E-07
Aroclor-1260		4.1E-08	5.2E-10	2.2E-07			2.6E-07
Arsenic	2.7E-07						2.7E-07
Benzene	4.1E-06				3.2E-05	7.3E-04	7.6E-04
Benzo(a)Anthracene		1.9E-08	2.5E-10	1.8E-07			2.0E-07
Benzo(a)Pyrene		1.7E-08	2.2E-10	1.6E-07			1.7E-07
Benzo(b)Fluoranthene		2.4E-08	3.1E-10	2.2E-07			2.4E-07
Bis(2-Ethylhexyl)Phthalate	6.2E-05						6.2E-05
Chromium	4.6E-06						4.6E-06
Dichloroethane, 1,2-	2.3E-07						2.3E-07
Dichloroethene, 1,1-	4.9E-07						4.9E-07
Dichloroethene, 1,2-	3.2E-06						3.2E-06
Dichloroethene, Cis-1,2-	2.3E-06						2.3E-06
Ethylbenzene					3.3E-05	7.5E-04	7.8E-04
Manganese		1.2E-04	1.6E-06	NA			1.3E-04
N-Nitrosodiphenylamine	5.6E-07						5.6E-07
Nickel	2.8E-06	3.2E-06	4.1E-08	2.9E-06			8.9E-06
Tetrachloroethene	2.8E-05						2.8E-05
Toluene					1.5E-04	3.4E-03	3.5E-03
Total Petroleum Hydrocarbons	5.5E-02	4.9E-05	6.2E-07	1.1E-03			5.6E-02
Trichloroethane, 1,1,1-	6.3E-05						6.3E-05
Trichloroethane, 1,1,2-	3.3E-07						3.3E-07
Trichloroethene	3.0E-04	5.5E-07	7.1E-09	1.3E-05			3.2E-04
Vinyl Acetate	4.4E-07						4.4E-07
Vinyl Chloride	1.6E-07	5.7E-10	7.3E-12	1.3E-08			1.8E-07
Xylenes					2.4E-04	5.5E-03	5.7E-03
Pathway-Specific Subtotal	5.6E-02	1.8E-04	2.3E-06	1.1E-03	4.6E-04	1.0E-02	7E-02
% of Total	82.1%	0.3%	0.0%	1.7%	0.7%	15.3%	100.0%

NA Not applicable.

TABLE 5-24
OPERABLE UNIT 1:
SUMMARY OF LADDs FOR AN EXCAVATION WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Perched Groundwater			Total Soil		Sediment		Chemical-Specific
	Dermal	Oral	Inhalation	Dermal	Oral	Dermal	Subtotal	
	MLE LADDs (mg/kg-day)							
Aroclor-1242	2.6E-11						2.6E-11	
Aroclor-1248	7.8E-09	7.4E-11	3.5E-12	2.0E-10			8.1E-09	
Aroclor-1254		2.4E-11	1.1E-12	6.4E-11			8.9E-11	
Aroclor-1260		2.2E-11	1.0E-12	5.9E-11			8.1E-11	
Arsenic	3.3E-11						3.3E-11	
Benzene	2.4E-09				5.8E-09	6.5E-08	7.3E-08	
Benzo(a)Anthracene		1.3E-11	6.0E-13	5.7E-11			7.0E-11	
Benzo(a)Pyrene		1.1E-11	5.3E-13	5.0E-11			6.2E-11	
Benzo(b)Fluoranthene		1.6E-11	7.7E-13	7.2E-11			8.9E-11	
Bis(2-Ethylhexyl)Phthalate	9.7E-09						9.7E-09	
Chromium	3.3E-10						3.3E-10	
Dichloroethane, 1,2-	2.0E-10						2.0E-10	
Dichloroethene, 1,1-	3.1E-10						3.1E-10	
Dichloroethene, 1,2-	1.4E-09						1.4E-09	
Dichloroethene, Cis-1,2-	7.0E-10						7.0E-10	
Ethylbenzene					5.9E-09	6.7E-08	7.3E-08	
Manganese		5.5E-08	2.6E-09	NA			5.8E-08	
N-Nitrosodiphenylamine	3.9E-10						3.9E-10	
Nickel	2.1E-10	1.5E-09	7.1E-11	6.7E-10			2.4E-09	
Tetrachloroethene	2.5E-08						2.5E-08	
Toluene					2.7E-08	3.0E-07	3.3E-07	
Total Petroleum Hydrocarbons	1.2E-05	3.3E-08	1.6E-09	3.7E-07			1.3E-05	
Trichloroethane, 1,1,1-	3.3E-08						3.3E-08	
Trichloroethane, 1,1,2-	2.9E-10						2.9E-10	
Trichloroethene	1.4E-07	3.5E-11	1.7E-12	4.0E-10			1.4E-07	
Vinyl Acetate	2.0E-10						2.0E-10	
Vinyl Chloride	1.4E-10	3.4E-13	1.6E-14	3.9E-12			1.4E-10	
Xylenes					4.3E-08	4.9E-07	5.4E-07	
Pathway-Specific Subtotal	1.2E-05	9.0E-08	4.3E-09	3.7E-07	8.2E-08	9.3E-07	1E-05	
% of Total	89.4%	0.6%	0.0%	2.7%	0.6%	6.7%	100.0%	
RME LADDs (mg/kg-day)								
Aroclor-1242	1.5E-09						1.5E-09	
Aroclor-1248	9.6E-07	2.7E-09	3.5E-11	1.5E-08			9.8E-07	
Aroclor-1254		6.4E-10	8.2E-12	3.5E-09			4.1E-09	
Aroclor-1260		5.8E-10	7.5E-12	3.2E-09			3.8E-09	
Arsenic	3.9E-09						3.9E-09	
Benzene	5.8E-08				4.6E-07	1.0E-05	1.1E-05	
Benzo(a)Anthracene		2.8E-10	3.5E-12	2.5E-09			2.8E-09	
Benzo(a)Pyrene		2.5E-10	3.2E-12	2.2E-09			2.5E-09	
Benzo(b)Fluoranthene		3.4E-10	4.4E-12	3.1E-09			3.4E-09	
Bis(2-Ethylhexyl)Phthalate	8.9E-07						8.9E-07	
Chromium	6.6E-08						6.6E-08	
Dichloroethane, 1,2-	3.2E-09						3.2E-09	
Dichloroethene, 1,1-	7.0E-09						7.0E-09	
Dichloroethene, 1,2-	4.6E-08						4.6E-08	
Dichloroethene, Cis-1,2-	3.3E-08						3.3E-08	
Ethylbenzene					4.7E-07	1.1E-05	1.1E-05	
Manganese		1.8E-06	2.3E-08	NA			1.8E-06	
N-Nitrosodiphenylamine	8.0E-09						8.0E-09	
Nickel	4.0E-08	4.6E-08	5.9E-10	4.1E-08			1.3E-07	
Tetrachloroethene	3.9E-07						3.9E-07	
Toluene					2.1E-06	4.8E-05	5.0E-05	
Total Petroleum Hydrocarbons	7.9E-04	6.9E-07	8.9E-09	1.6E-05			8.0E-04	
Trichloroethane, 1,1,1-	9.0E-07						9.0E-07	
Trichloroethane, 1,1,2-	4.7E-09						4.7E-09	
Trichloroethene	4.4E-06	7.9E-09	1.0E-10	1.8E-07			4.5E-06	
Vinyl Acetate	6.3E-09						6.3E-09	
Vinyl Chloride	2.4E-09	8.1E-12	1.0E-13	1.8E-10			2.5E-09	
Xylenes					3.5E-06	7.9E-05	8.2E-05	
Pathway-Specific Subtotal	7.9E-04	2.5E-06	3.2E-08	1.6E-05	6.5E-06	1.5E-04	1E-03	
% of Total	82.1%	0.3%	0.0%	1.7%	0.7%	15.3%	100.0%	

NA Not applicable.

TABLE 5-25
OPERABLE UNIT 1:
SUMMARY OF ADDs FOR AN INDOOR WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Indoor Air Inhalation*	Chemical-Specific Subtotal
MLE ADDs (mg/kg-day)		
Benzene	9.6E-07	9.6E-07
Dichloroethane, 1,2-	5.8E-07	5.8E-07
Dichloroethene, 1,1-	3.2E-06	3.2E-06
Dichloroethene, 1,2-	1.1E-05	1.1E-05
Dichloroethene, Cis-1,2-	5.4E-06	5.4E-06
N-Nitrosodiphenylamine		
Tetrachloroethene	2.4E-06	2.4E-06
Trichloroethane, 1,1,1-	1.5E-04	1.5E-04
Trichloroethane, 1,1,2-	1.9E-07	1.9E-07
Trichloroethene	2.6E-05	2.6E-05
Vinyl Chloride	4.4E-06	4.4E-06
Vinyl Acetate	2.2E-06	2.2E-06
Pathway-Specific Subtotal	2.1E-04	2E-04
% of Total	100.0%	100.0%
RME ADDs (mg/kg-day)		
Benzene	1.3E-06	1.3E-06
Dichloroethane, 1,2-	7.8E-07	7.8E-07
Dichloroethene, 1,1-	4.2E-06	4.2E-06
Dichloroethene, 1,2-	1.4E-05	1.4E-05
Dichloroethene, Cis-1,2-	7.3E-06	7.3E-06
N-Nitrosodiphenylamine		
Tetrachloroethene	3.2E-06	3.2E-06
Trichloroethane, 1,1,1-	2.1E-04	2.1E-04
Trichloroethane, 1,1,2-	2.7E-07	2.7E-07
Trichloroethene	3.6E-05	3.6E-05
Vinyl Chloride	5.8E-06	5.8E-06
Vinyl Acetate	3.0E-06	3.0E-06
Pathway-Specific Subtotal	2.8E-04	3E-04
% of Total	100.0%	100.0%

* Values for chemicals are not shown when low volatility combined with low concentrations results in insignificant emissions which the models round to zero.

TABLE 5-26
OPERABLE UNIT 1:
SUMMARY OF LADDs FOR AN INDOOR WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Indoor Air Inhalation	Chemical-Specific Subtotal
MLE LADDs (mg/kg-day)		
Benzene	5.7E-08	5.7E-08
Dichloroethane, 1,2-	3.5E-08	3.5E-08
Dichloroethene, 1,1-	1.9E-07	1.9E-07
Dichloroethene, 1,2-	6.3E-07	6.3E-07
Dichloroethene, Cis-1,2-	3.3E-07	3.3E-07
N-Nitrosodiphenylamine	NA	NA
Tetrachloroethene	1.4E-07	1.4E-07
Trichloroethane, 1,1,1-	9.2E-06	9.2E-06
Trichloroethane, 1,1,2-	1.1E-08	1.1E-08
Trichloroethene	1.6E-06	1.6E-06
Vinyl Chloride	2.6E-07	2.6E-07
Vinyl Acetate	1.3E-07	1.3E-07
Pathway-Specific Subtotal	1.3E-05	1E-05
% of Total	100.0%	100.0%
RME LADDs (mg/kg-day)		
Benzene	4.6E-07	4.6E-07
Dichloroethane, 1,2-	2.8E-07	2.8E-07
Dichloroethene, 1,1-	1.5E-06	1.5E-06
Dichloroethene, 1,2-	5.1E-06	5.1E-06
Dichloroethene, Cis-1,2-	2.6E-06	2.6E-06
N-Nitrosodiphenylamine	NA	NA
Tetrachloroethene	1.2E-06	1.2E-06
Trichloroethane, 1,1,1-	7.3E-05	7.3E-05
Trichloroethane, 1,1,2-	9.5E-08	9.5E-08
Trichloroethene	1.3E-05	1.3E-05
Vinyl Chloride	2.1E-06	2.1E-06
Vinyl Acetate	1.1E-06	1.1E-06
Pathway-Specific Subtotal	1.0E-04	1E-04
% of Total	100.0%	100.0%

* Values for chemicals are not shown when low volatility combined with low concentrations results in insignificant emissions which the models round to zero.

TABLE 5-27
OPERABLE UNIT 2:
SUMMARY OF ADDs FOR A GENERAL WORKER
GEAE EVENDALE
(Page 1 of 1)

	Ambient Air		Surface Soil		Chemical-Specific
Chemical	Inhalation	Oral	Inhalation	Dermal	Subtotal
MLE ADDs (mg/kg-day)					
Benzene	2.4E-06				2.4E-06
Total Petroleum Hydrocarbons		3.9E-05	1.4E-11	4.4E-04	4.8E-04
Trichloroethene	5.5E-05				5.5E-05
Vinyl Chloride	7.2E-07				7.2E-07
Pathway-Specific Subtotal	5.9E-05	3.9E-05	1.4E-11	4.4E-04	5E-04
% of Total	10.8%	7.2%	0.0%	81.9%	100.0%
RME ADDs (mg/kg-day)					
Benzene	7.7E-07				7.7E-07
Total Petroleum Hydrocarbons		1.2E-03	1.2E-10	2.8E-02	2.9E-02
Trichloroethene	1.7E-05				1.7E-05
Vinyl Chloride	1.8E-07				1.8E-07
Pathway-Specific Subtotal	1.8E-05	1.2E-03	1.2E-10	2.8E-02	3E-02
% of Total	0.1%	4.2%	0.0%	95.7%	100.0%

TABLE 5-28
OPERABLE UNIT 2:
SUMMARY OF LADDs FOR A GENERAL WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Ambient Air		Surface Soil		Chemical-Specific Subtotal
	Inhalation	Oral	Inhalation	Dermal	
MLE LADDs (mg/kg-day)					
Benzene	1.4E-07				1.4E-07
Total Petroleum Hydrocarbons		2.3E-06	8.4E-13	2.7E-05	2.9E-05
Trichloroethene	3.3E-06				3.3E-06
Vinyl Chloride	4.3E-08				4.3E-08
Pathway-Specific Subtotal	3.5E-06	2.3E-06	8.4E-13	2.7E-05	3E-05
% of Total	10.8%	7.2%	0.0%	81.9%	100.0%
RME LADDs (mg/kg-day)					
Benzene	2.7E-07				2.7E-07
Total Petroleum Hydrocarbons		4.4E-04	4.2E-11	1.0E-02	1.1E-02
Trichloroethene	6.0E-06				6.0E-06
Vinyl Chloride	6.3E-08				6.3E-08
Pathway-Specific Subtotal	6.4E-06	4.4E-04	4.2E-11	1.0E-02	1E-02
% of Total	0.1%	4.2%	0.0%	95.7%	100.0%

TABLE 5-29
OPERABLE UNIT 2:
SUMMARY OF ADDs FOR AN EXCAVATION WORKER
GEAE EVENDALE
(Page 1 of 1)

	Perched Groundwater	Total Soil		Sediment		Chemical-Specific	
Chemical	Dermal	Oral	Inhalation	Dermal	Oral	Dermal	Subtotal
MLE ADDs (mg/kg-day)							
Benzene	7.0E-08	5.9E-11	2.9E-12	6.7E-10	9.6E-09	1.1E-07	1.9E-07
Bis(2-Ethylhexyl)Phthalate	7.3E-08						7.3E-08
Cadmium	6.1E-10						6.1E-10
Chromium	1.3E-08						1.3E-08
Dibenzofuran	8.8E-07						8.8E-07
Dichloroethane, 1,2-	8.2E-09						8.2E-09
Dichloroethene, 1,1-	6.1E-08						6.1E-08
Dichloroethene, Cis-1,2-	1.9E-07						1.9E-07
Fluorene	3.5E-06						3.5E-06
Lead					8.2E-07	NA	8.2E-07
Manganese					2.8E-06	NA	2.8E-06
Methylene Chloride	9.5E-09						9.5E-09
Methylnaphthalene, 2-	2.5E-05						2.5E-05
Naphthalene	3.4E-06						3.4E-06
Nickel	2.3E-08						2.3E-08
Phenanthrene	5.0E-06						5.0E-06
Tetrachloroethene	8.1E-07						8.1E-07
Total Petroleum Hydrocarbons	1.3E+00	1.8E-06	8.9E-08	2.1E-05			1.3E+00
Trichloroethane, 1,1,1-	6.7E-07						6.7E-07
Trichloroethene	2.1E-05						2.1E-05
Vinyl Chloride	1.0E-08						1.0E-08
Xylenes					5.9E-08	6.7E-07	7.2E-07
Pathway-Specific Subtotal	1.3E+00	1.8E-06	8.9E-08	2.1E-05	3.7E-06	7.8E-07	1E+00
% of Total	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
RME ADDs (mg/kg-day)							
Benzene	1.3E-06	2.2E-09	2.8E-11	5.0E-08	1.2E-06	2.6E-05	2.9E-05
Bis(2-Ethylhexyl)Phthalate	1.2E-06						1.2E-06
Cadmium	1.2E-08						1.2E-08
Chromium	1.2E-06						1.2E-06
Dibenzofuran	1.6E-05						1.6E-05
Dichloroethane, 1,2-	1.3E-07						1.3E-07
Dichloroethene, 1,1-	1.8E-06						1.8E-06
Dichloroethene, Cis-1,2-	8.7E-06						8.7E-06
Fluorene	6.1E-05						6.1E-05
Lead					4.4E-05	NA	4.4E-05
Manganese					1.3E-04	NA	1.3E-04
Methylene Chloride	3.7E-07						3.7E-07
Methylnaphthalene, 2-	6.9E-04						6.9E-04
Naphthalene	5.9E-05						5.9E-05
Nickel	2.9E-06						2.9E-06
Phenanthrene	8.4E-05						8.4E-05
Tetrachloroethene	3.2E-05						3.2E-05
Total Petroleum Hydrocarbons	4.2E+01	3.1E-04	4.0E-06	7.1E-03			4.2E+01
Trichloroethane, 1,1,1-	5.5E-05						5.5E-05
Trichloroethene	1.8E-03						1.8E-03
Vinyl Chloride	2.0E-07						2.0E-07
Xylenes					2.3E-05	5.2E-04	5.4E-04
Pathway-Specific Subtotal	4.2E+01	3.1E-04	4.0E-06	7.1E-03	1.9E-04	5.4E-04	4E+01
% of Total	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%

NA Not applicable.

TABLE 5-30
OPERABLE UNIT 2:
SUMMARY OF LADDs FOR AN EXCAVATION WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Perched Groundwater	Total Soil			Sediment		Chemical-Specific
	Dermal	Oral	Inhalation	Dermal	Oral	Dermal	Subtotal
	MLE LADDs (mg/kg-day)						
Benzene	9.9E-10	8.5E-13	4.1E-14	9.6E-12	1.4E-10	1.6E-09	2.7E-09
Bis(2-Ethylhexyl)Phthalate	1.0E-09						1.0E-09
Cadmium	8.7E-12						8.7E-12
Chromium	1.9E-10						1.9E-10
Dibenzofuran	1.3E-08						1.3E-08
Dichloroethane, 1,2-	1.2E-10						1.2E-10
Dichloroethene, 1,1-	8.7E-10						8.7E-10
Dichloroethene, Cis-1,2-	2.7E-09						2.7E-09
Fluorene	5.0E-08						5.0E-08
Lead					1.2E-08	NA	1.2E-08
Manganese					4.0E-08	NA	4.0E-08
Methylene Chloride	1.4E-10						1.4E-10
Methylnaphthalene, 2-	3.6E-07						3.6E-07
Naphthalene	4.8E-08						4.8E-08
Nickel	3.3E-10						3.3E-10
Phenanthrene	7.1E-08						7.1E-08
Tetrachloroethene	1.2E-08						1.2E-08
Total Petroleum Hydrocarbons	1.9E-02	2.6E-08	1.3E-09	3.0E-07			1.9E-02
Trichloroethane, 1,1,1-	9.6E-09						9.6E-09
Trichloroethene	3.1E-07						3.1E-07
Vinyl Chloride	1.4E-10						1.4E-10
Xylenes					8.4E-10	9.5E-09	1.0E-08
Pathway-Specific Subtotal	1.9E-02	2.6E-08	1.3E-09	3.0E-07	5.3E-08	1.1E-08	2E-02
% of Total	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
RME LADDs (mg/kg-day)							
Benzene	1.8E-08	3.1E-11	4.0E-13	7.1E-10	1.7E-08	3.7E-07	4.1E-07
Bis(2-Ethylhexyl)Phthalate	1.7E-08						1.7E-08
Cadmium	1.7E-10						1.7E-10
Chromium	1.7E-08						1.7E-08
Dibenzofuran	2.3E-07						2.3E-07
Dichloroethane, 1,2-	1.9E-09						1.9E-09
Dichloroethene, 1,1-	2.6E-08						2.6E-08
Dichloroethene, Cis-1,2-	1.2E-07						1.2E-07
Fluorene	8.7E-07						8.7E-07
Lead					6.3E-07	NA	6.3E-07
Manganese					1.8E-06	NA	1.8E-06
Methylene Chloride	5.3E-09						5.3E-09
Methylnaphthalene, 2-	9.8E-06						9.8E-06
Naphthalene	8.4E-07						8.4E-07
Nickel	4.2E-08						4.2E-08
Phenanthrene	1.2E-06						1.2E-06
Tetrachloroethene	4.6E-07						4.6E-07
Total Petroleum Hydrocarbons	6.0E-01	4.5E-06	5.8E-08	1.0E-04			6.0E-01
Trichloroethane, 1,1,1-	7.8E-07						7.8E-07
Trichloroethene	2.6E-05						2.6E-05
Vinyl Chloride	2.9E-09						2.9E-09
Xylenes					3.2E-07	7.4E-06	7.7E-06
Pathway-Specific Subtotal	6.0E-01	4.5E-06	5.8E-08	1.0E-04	2.8E-06	7.7E-06	6E-01
% of Total	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%

NA Not applicable.

TABLE 5-31
OPERABLE UNIT 2:
SUMMARY OF ADDs FOR AN INDOOR WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Indoor Air Inhalation*	Chemical-Specific Subtotal
MLE ADDs (mg/kg-day)		
Benzene	3.2E-07	3.2E-07
Dibenzofuran		
Dichloroethane, 1,2-	3.4E-07	3.4E-07
Dichloroethene, 1,1-	1.2E-05	1.2E-05
Dichloroethene, Cis-1,2-	2.1E-05	2.1E-05
Fluorene		
Methylene Chloride	2.8E-06	2.8E-06
Methylnaphthalene, 2-		
Naphthalene		
Phenanthrene		
Tetrachloroethene	2.9E-06	2.9E-06
Trichloroethane, 1,1,1-	1.4E-04	1.4E-04
Trichloroethene	1.6E-04	1.6E-04
Vinyl Chloride	5.5E-06	5.5E-06
Pathway-Specific Subtotal	3.4E-04	3E-04
% of Total	100.0%	100.0%
RME ADDs (mg/kg-day)		
Benzene	4.3E-07	4.3E-07
Dibenzofuran	2.6E-09	2.6E-09
Dichloroethane, 1,2-	4.6E-07	4.6E-07
Dichloroethene, 1,1-	1.6E-05	1.6E-05
Dichloroethene, Cis-1,2-	2.8E-05	2.8E-05
Fluorene		
Methylene Chloride	3.7E-06	3.7E-06
Methylnaphthalene, 2-		
Naphthalene	3.5E-08	3.5E-08
Phenanthrene		
Tetrachloroethene	3.9E-06	3.9E-06
Trichloroethane, 1,1,1-	1.9E-04	1.9E-04
Trichloroethene	2.1E-04	2.1E-04
Vinyl Chloride	7.3E-06	7.3E-06
Pathway-Specific Subtotal	4.6E-04	5E-04
% of Total	100.0%	100.0%

* Values for chemicals are not shown when low volatility combined with low concentrations results in insignificant emissions which the models round to zero.

TABLE 5-32
OPERABLE UNIT 2:
SUMMARY OF LADDs FOR AN INDOOR WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Indoor Air Inhalation	Chemical-Specific Subtotal
MLE LADDs (mg/kg-day)		
Benzene	1.9E-08	1.9E-08
Dibenzofuran		
Dichloroethane, 1,2-	2.0E-08	2.0E-08
Dichloroethene, 1,1-	7.0E-07	7.0E-07
Dichloroethene, Cis-1,2-	1.2E-06	1.2E-06
Fluorene		
Methylene Chloride	1.7E-07	1.7E-07
Methylnaphthalene, 2-		
Naphthalene		
Phenanthrene		
Tetrachloroethene	1.7E-07	1.7E-07
Trichloroethane, 1,1,1-	8.4E-06	8.4E-06
Trichloroethene	9.4E-06	9.4E-06
Vinyl Chloride	3.3E-07	3.3E-07
Pathway-Specific Subtotal	2.0E-05	2E-05
% of Total	100.0%	100.0%
RME LADDs (mg/kg-day)		
Benzene	1.5E-07	1.5E-07
Dibenzofuran	9.3E-10	9.3E-10
Dichloroethane, 1,2-	1.6E-07	1.6E-07
Dichloroethene, 1,1-	5.6E-06	5.6E-06
Dichloroethene, Cis-1,2-	1.0E-05	1.0E-05
Fluorene		
Methylene Chloride	1.3E-06	1.3E-06
Methylnaphthalene, 2-		
Naphthalene	1.3E-08	1.3E-08
Phenanthrene		
Tetrachloroethene	1.4E-06	1.4E-06
Trichloroethane, 1,1,1-	6.7E-05	6.7E-05
Trichloroethene	7.6E-05	7.6E-05
Vinyl Chloride	2.6E-06	2.6E-06
Pathway-Specific Subtotal	1.6E-04	2E-04
% of Total	100.0%	100.0%

* Values for chemicals are not shown when low volatility combined with low concentrations results in insignificant emissions which the models round to zero.

TABLE 5-33
OPERABLE UNIT 3:
SUMMARY OF ADDs FOR A RESIDENT
GEAE EVENDALE
(Page 1 of 1)

Chemical	Ambient Air Inhalation	Chemical-Specific Subtotal
MLE ADDs (mg/kg-day)		
Benzene	2.4E-06	2.4E-06
Trichloroethene	1.0E-03	1.0E-03
Vinyl Chloride	1.2E-05	1.2E-05
Pathway-Specific Subtotal	1.0E-03	1E-03
% of Total	100.0%	100.0%
RME ADDs (mg/kg-day)		
Benzene	5.4E-07	5.4E-07
Trichloroethene	2.2E-04	2.2E-04
Vinyl Chloride	2.3E-06	2.3E-06
Pathway-Specific Subtotal	2.2E-04	2E-04
% of Total	100.0%	100.0%

TABLE 5-34
OPERABLE UNIT 3:
SUMMARY OF LADDs FOR A RESIDENT
GEAE EVENDALE
(Page 1 of 1)

Chemical	Ambient Air Inhalation	Chemical-Specific Subtotal
MLE LADDs (mg/kg-day)		
Benzene	3.1E-07	3.1E-07
Trichloroethene	1.3E-04	1.3E-04
Vinyl Chloride	1.5E-06	1.5E-06
Pathway-Specific Subtotal	1.3E-04	1E-04
% of Total	100.0%	100.0%
RME LADDs (mg/kg-day)		
Benzene	2.3E-07	2.3E-07
Trichloroethene	9.4E-05	9.4E-05
Vinyl Chloride	9.7E-07	9.7E-07
Pathway-Specific Subtotal	9.5E-05	9E-05
% of Total	100.0%	100.0%

TABLE 5-35
OPERABLE UNIT 4:
SUMMARY OF ADDs FOR A GENERAL WORKER
GEAE EVENDALE
(Page 1 of 1)

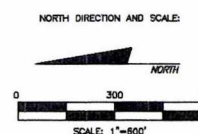
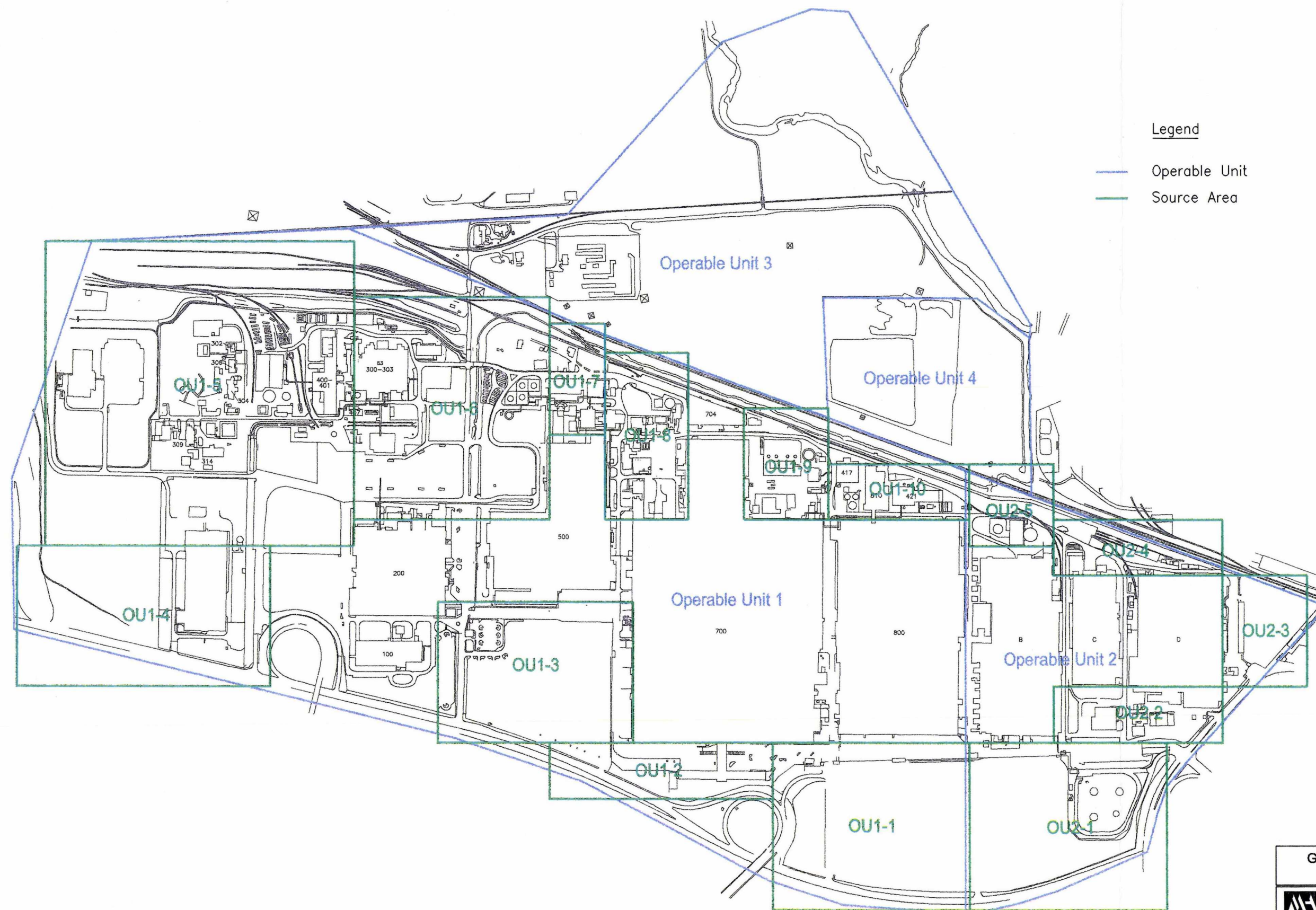
Chemical	Oral	Surface Soil		Ambient Air	Chemical-Specific Subtotal
		Inhalation	Dermal	Inhalation	
MLE ADDs (mg/kg-day)					
Arsenic	6.6E-06	2.3E-12	3.0E-06		9.6E-06
Benzene				1.0E-06	1.0E-06
Lead	1.0E-04	3.6E-11	NA		1.0E-04
Trichloroethene				1.4E-04	1.4E-04
Vinyl Chloride				1.8E-06	1.8E-06
Pathway-Specific Subtotal	1.1E-04	3.9E-11	3.0E-06	1.4E-04	3E-04
% of Total	43.0%	0.0%	1.2%	55.8%	100.0%
RME ADDs (mg/kg-day)					
Arsenic	1.1E-04	1.1E-11	1.0E-04		2.1E-04
Benzene				3.3E-07	3.3E-07
Lead	1.7E-03	1.6E-10	NA		1.7E-03
Trichloroethene				4.2E-05	4.2E-05
Vinyl Chloride				4.4E-07	4.4E-07
Pathway-Specific Subtotal	1.8E-03	1.8E-10	1.0E-04	4.3E-05	2E-03
% of Total	92.7%	0.0%	5.1%	2.1%	100.0%

NA Not applicable.

TABLE 5-36
OPERABLE UNIT 4:
SUMMARY OF LADDs FOR A GENERAL WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Oral	Surface Soil		Ambient Air	Chemical-Specific Subtotal
		Inhalation	Dermal	Inhalation	
MLE LADDs (mg/kg-day)					
Arsenic	3.9E-07	1.4E-13	1.8E-07		5.7E-07
Benzene				6.2E-08	6.2E-08
Lead	6.1E-06	2.2E-12	NA		6.1E-06
Trichloroethene				8.3E-06	8.3E-06
Vinyl Chloride				1.1E-07	1.1E-07
Pathway-Specific Subtotal	6.5E-06	2.3E-12	1.8E-07	8.4E-06	2E-05
% of Total	43.0%	0.0%	1.2%	55.8%	100.0%
RME LADDs (mg/kg-day)					
Arsenic	4.0E-05	3.8E-12	3.6E-05		7.7E-05
Benzene				1.2E-07	1.2E-07
Lead	6.2E-04	5.9E-11	NA		6.2E-04
Trichloroethene				1.5E-05	1.5E-05
Vinyl Chloride				1.6E-07	1.6E-07
Pathway-Specific Subtotal	6.6E-04	6.3E-11	3.6E-05	1.5E-05	7E-04
% of Total	92.7%	0.0%	5.1%	2.1%	100.0%

NA Not applicable.



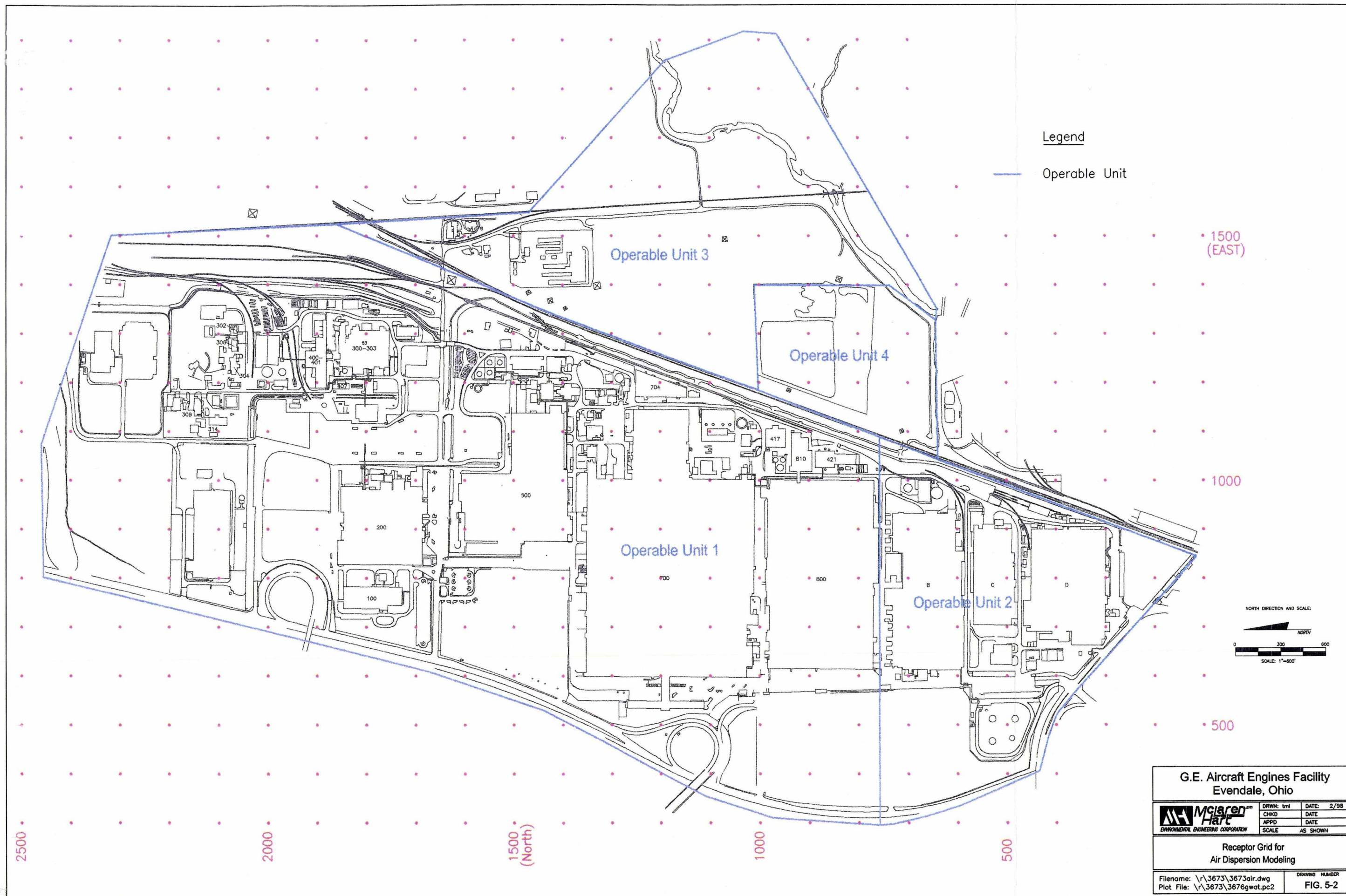
G.E. Aircraft Engines Facility
Evendale, Ohio

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Source Areas for
Air Dispersion Modeling

Filename: \r\3673\3673air.dwg
Plot File: \r\3673\3673gwot.pc2

DRAWING NUMBER
FIG. 5-1



6.0 RISK CHARACTERIZATION

This section characterizes the potential noncancer hazards and upper bound cancer risks for the exposure scenarios identified in the Exposure Assessment (Section 5.0). The potential health risks are characterized separately for noncarcinogenic and carcinogenic endpoints according to the methodologies presented in the approved Work Plan (Appendix A), as summarized below.

- The potential noncarcinogenic health risk estimates are determined using the Hazard Quotient/Index approach that defines the relative hazard based on the ratio of the estimated average daily dose (ADD) to the acceptable intake level (*i.e.*, the reference dose or RfD). A hazard index (HI) of 1 or less indicates that levels of exposure are acceptable (USEPA, 1989a). An HI which exceeds a value of 1 does not necessarily indicate that noncancer health effects are likely to occur. Rather, an HI value greater than one indicates that additional analysis of the underlying assumptions and data may be necessary. Therefore, in this assessment, a discussion of the key chemical(s) and pathways associated with potential noncancer hazards are identified only when an HI exceeds a value of 1.
- The potential carcinogenic health risk estimates are determined based on the probability that an individual may contract cancer in a lifetime from the estimated lifetime average daily dose (LADD). The theoretical excess cancer risk is determined for each potentially carcinogenic COI using the total LADD from all pathways and the cancer slope factor. Unlike the identification of risk issues for noncancer hazards, the identification of risk issues for cancer risk is dependent upon the selection of an acceptable or *de minimis* level. For risk assessment and regulatory purposes, cancer risks of less than 1×10^{-6} are considered *de minimis* and no further action is typically concluded. Potential carcinogenic health risks are evaluated using both the *de minimis* lifetime cancer risk level of 1×10^{-6} (*i.e.*, zero risk) and the acceptable regulatory risk range of 1×10^{-6} to 1×10^{-4} (OSWER Directive 9355.0-30 (USEPA, 1991c)). In this assessment, a discussion of the key chemical(s) and pathways associated with potential cancer risks will be identified only when a cancer risk estimate exceeds the *de minimis* level (1×10^{-6}).

As discussed in the Exposure Assessment (Section 5.0), a range of hazard indices and cancer risk estimates are presented using most likely exposure (MLE) and reasonable maximum exposure (RME) assumptions. Estimates of noncancer and cancer risks are presented for each scenario based on the toxicological benchmarks presented in Section 4.0 and the ADDs (noncancer) and LADDs (cancer) that are derived in the Exposure Assessment (Section 5.0). Potential health risks for all operable units are discussed in Sections 6.1 through 6.4 and summarized in Section 6.5. A discussion of the uncertainties associated with the risk assessment process is presented in Section 6.6.

6.1 Operable Unit 1

Operable Unit 1 consists of the active production area west of the Main Drainage Ditch and north of the former Air Force Plant 36 (Figure 2-2). Three exposure scenarios are evaluated for Operable Unit 1: (1) General Worker (Outdoor) Scenario, (2) Indoor Worker Scenario, and (3) Excavation Worker Scenario. The General Worker and Indoor Worker Scenarios are considered appropriate for Operable Unit 1 based on the fact that this area will remain an active industrial area into the foreseeable future. Because small-scale excavations may occur in the future, an Excavation Worker Scenario is also evaluated.

6.1.1 Noncancer Risk Estimates (Hazard Indices)

The chemical-specific and pathway-specific hazard indices for all Operable Unit 1 scenarios are presented in Tables 6-1 through 6-3 and are discussed below.

General Worker Scenario

The hazard indices for the General Worker range from 0.6 (MLE) to 70 (RME) (Table 6-1). The major contributors to the RME hazard index are dermal contact with and ingestion of Aroclor-1248 in surface soil (Outdoor) and dermal contact with total petroleum hydrocarbons (TPH) in surface soil (Table 6-1). Surface soil samples were only analyzed for polychlorinated biphenyls (PCBs) in the Scrapyard Area: SWMUs 8 (Temporary Drum Storage Area) and 12 (Drum Crusher Unit) (Figure 6-1). Elevated concentrations of TPH were detected at SWMUs 8, 12, 136 (Well Cuttings Drum Storage Area), 142 (Building 800 Machine Sump), and Building 306. There are three reasons why the RME HI may overstate risks and thus not be fully representative:

- (1) The RME hazard quotients for dermal contact with and ingestion of Aroclor-1248 are calculated using the maximum concentration (390 mg/kg) as the exposure point concentration. Concentrations of Aroclor-1248 at SWMUs 8 and 12 range from 0.28 (nondetect) to 390 mg/kg with a mean concentration of 73 mg/kg (Figure 6-1). It should be noted that exposures at these areas are not expected to occur under current conditions since surface soil is capped with asphalt and concrete.
- (2) This baseline HHRA assumed that the general outdoor worker would be exposed to the maximum Aroclor concentration at SWMU 8/12 as a result of conservative approaches adopted in data evaluation and in calculating the exposure concentration term for the RME. The primary contributor to risk estimates (hazard quotient and cancer risk) is the maximum concentration of Aroclor 1248 at SWMU 8/12. The conservative assumption of using a maximum concentration for the RME evaluation is largely a result of a detection frequency less than 50%. The higher number of nondetect values skews the data distribution from a normal gaussian distribution to a lognormal one which results in statistical descriptors (mean and UCL) that are biased at the extreme end because of uncertainty. All other areas within OU1 are not expected to pose an unacceptable noncancer risk to the general worker (outdoor). The

area defined by SWMU 8/12 comprises less than 1% of OU1 and a general worker is not routinely engaged in activities in this area.

- (3) The RME hazard quotient for dermal contact with TPH (HQ = 1.1) is calculated using the maximum concentration (46,000 mg/kg) as the exposure point concentration. Although this excursion is slightly above 1, no health concerns are expected since it is unlikely that a worker will continuously contact the maximum concentration. Additionally, a 10% excursion above 1 is essentially meaningless in terms of predicting a potential health effect.
- (4) Since the TPH source at the site is uncharacterized, it is conservatively assumed to be Group 1. Therefore, the RME hazard quotient for dermal contact with TPH (1.1) is calculated using the most conservative value (0.48 mg/kg-day) for the RfD (see Section 4.0). However, if the TPH is characterized as a heavier fraction (Group 2 or 3), the RME hazard quotient for dermal contact is less than 1: 0.84 (Group 2) or 0.28 (Group 3). It is probable that the TPH fraction remaining in soil is the heavier fraction (*i.e.*, Group 2 or 3) because of attenuating factors such as volatilization, biodegradation and dilution of the lighter fraction.

Excavation Worker Scenario

The hazard indices for the Excavation Worker Scenario range from 0.05 (MLE) to 4 (RME) (Table 6-2). Dermal contact with benzene in sediment and dermal contact with Aroclor-1248 in perched groundwater contribute 92% of the RME hazard index (Table 6-2). There are three reasons why the RME HI may overstate risks and thus not be fully representative:

- (1) The hazard index associated with dermal contact with benzene in sediment is calculated using the maximum concentration (*i.e.*, the only detected concentration) of 820 mg/kg which was detected in the sample from the 500-1 Oil/Water Separator at Building 500. The mean value is 210 mg/kg and is approximately 4-fold less than the maximum.
- (2) The RME exposure point concentration for dermal contact with Aroclor-1248 in groundwater is the maximum detected concentration (0.026 mg/L) from sample 95-MW3S which is located downgradient of Oil/Water Separator 500-2 located near the northeast corner of Building 700 (Figure 3-2). The measurement of PCBs in groundwater is likely to be an artifact of suspended solids (sediment) in groundwater or remnants of soil material that resulted from well installation.
- (3) This baseline HHRA assumed that the excavation worker would be exposed to the maximum Aroclor groundwater concentration and benzene sediment concentration as a result of conservative approaches adopted in data evaluation and in calculating the exposure concentration term for the RME. The primary contributor to risk estimates (hazard quotient and cancer risk) is the maximum concentration of Aroclor 1248

(perched groundwater) at Oil/Water Separator 500-1 and benzene (sediment) at Oil/Water Separator 500-2. The conservative assumption of using a maximum concentration for the RME evaluation is largely a result of a detection frequency less than 50%. The higher number of nondetect values skews the data distribution from a normal gaussian distribution to a lognormal one which results in statistical descriptors (mean and UCL) that are biased at the extreme end because of uncertainty. All other areas within OU1 are not expected to pose an unacceptable noncancer risk to the excavation worker. The area defined by Oil Water Separator (500-1 & 500-2) comprises less than 1% of OU1 and a general worker is not routinely engaged in activities in this area.

Indoor Worker Scenario

The hazard indices for the Indoor Worker Scenario range from 0.006 (MLE) to 0.009 (RME) (Table 6-3). Since the HIs are less than 1, potential noncancer hazards are not significant for this scenario and residual chemicals do not pose an unacceptable risk.

6.1.2 Cancer Risk Estimates

The chemical-specific and pathway-specific cancer risk estimates for all Operable Unit 1 scenarios are presented in Tables 6-4 through 6-6 and are discussed below.

General Worker Scenario

The cancer risk estimates for the General Worker Scenario range from 4×10^{-6} (MLE) to 9×10^{-4} (RME) (Table 6-4). Dermal contact with and ingestion of Aroclor-1248 in surface soil contribute 87% and 99% of the MLE and RME cancer risk estimates, respectively (Table 6-4). There are three reasons why the cancer risk estimates overstate risks and thus not be fully representative:

- (1) The RME cancer risk estimates for dermal contact with and ingestion of Aroclor-1248 in surface soil are calculated using the maximum concentration (390 mg/kg) as the exposure point concentration. As discussed in Section 6.1.1, the area containing the maximum concentration is currently capped thereby precluding any exposures.
- (2) The dermal contact cancer risk estimates are calculated using an absorption factor of 0.06. However, the absorption factor for Aroclors in soil can vary depending on the organic content of the soil: 0.021 (low organic content) to 0.0063 (high organic content) (USEPA, 1992a). The cancer risk estimates for dermal contact with Aroclor-1248 in surface soil would be 8.6×10^{-7} (MLE) and 2.7×10^{-4} (RME) for low organic content soil and 2.6×10^{-7} (MLE) and 8.2×10^{-5} (RME) for high organic content soil.
- (3) A conservative slope factor of $2 \text{ (mg/kg/day)}^{-1}$ is used to calculate the cancer risk estimates for dermal contact with Aroclor-1248: 2.5×10^{-6} (MLE) and 7.8×10^{-4} (RME) (Table 6-4). EPA has developed a tiered-approach to determine the cancer potency of PCBs (USEPA, 1997). The slope factor used in this assessment is the

upper bound value for Tier 1 (high risk and persistence). If the Tier 2 (low risk and persistence) upper bound value of $0.4 \text{ (mg/kg/day)}^{-1}$ is used, the cancer risk estimates are approximately 5-fold less, or 4.7×10^{-7} (MLE) and 1.5×10^{-4} (RME). This may be appropriate since the area is capped, access is restrictive and children are not present.

- (4) This baseline HHRA assumed that the general outdoor worker would be exposed to the maximum Aroclor concentration at SWMU 8/12 as a result of conservative approaches adopted in data evaluation and in calculating the exposure concentration term for the RME. The primary contributor to risk estimates (hazard quotient and cancer risk) is the maximum concentration of Aroclor 1248 at SWMU 8/12. The conservative assumption of using a maximum concentration for the RME evaluation is largely a result of a detection frequency less than 50%. The higher number of nondetect values skews the data distribution from a normal gaussian distribution to a lognormal one which results in statistical descriptors (mean and UCL) that are biased at the extreme end because of uncertainty. All other areas within OU1 are not expected to pose an unacceptable cancer risk to the general worker (outdoor). The area defined by SWMU 8/12 comprises less than 1% of OU1 and a general worker is not routinely engaged in activities in this area.

Excavation Worker Scenario

The cancer risk estimates for the Excavation Worker Scenario range from 2×10^{-8} (MLE) to 2×10^{-6} (RME) (Table 6-5). The RME risk estimate is only slightly above the *de minimis* level of 1×10^{-6} and indicates an insignificant risk for the Excavation Worker. Dermal contact with Aroclor-1248 in perched groundwater contributes 82% of the RME cancer risk estimate (Table 6-5). There are two reasons why the RME cancer risk estimate overstate risks and thus not be fully representative:

- (1) The RME cancer risk estimate for dermal contact with Aroclor-1248 in groundwater is calculated using the maximum detected concentration (0.026 mg/L).
- (2) A conservative slope factor of $2 \text{ (mg/kg/day)}^{-1}$ is used to calculate the RME cancer risk estimate for Aroclor-1248 (2×10^{-6}). USEPA has developed a tiered-approach to determine the cancer potency of PCBs (USEPA, 1997). The slope factor used in this assessment is the upper bound value for Tier 1 (high risk and persistence). If the Tier 2 (low risk and persistence) upper bound value of $0.4 \text{ (mg/kg/day)}^{-1}$ is used, the RME cancer risk estimate is 3.8×10^{-7} . This may be appropriate since the area is capped, access is restrictive and children are not present.
- (3) This baseline HHRA assumed that the excavation worker would be exposed to the maximum Aroclor groundwater concentration as a result of conservative approaches adopted in data evaluation and in calculating the exposure concentration term for the RME. The primary contributor to risk estimates (hazard quotient and cancer risk) is the maximum concentration of Aroclor 1248 (perched groundwater) at Oil/Water Separator 500-1. The conservative assumption of using a maximum concentration for

the RME evaluation is largely a result of a detection frequency less than 50%. The higher number of nondetect values skews the data distribution from a normal gaussian distribution to a lognormal one which results in statistical descriptors (mean and UCL) that are biased at the extreme end because of uncertainty. All other areas within OUI are not expected to pose an unacceptable noncancer risk to the excavation worker. The area defined by Oil Water Separator 500-1 comprises less than 1% of OUI and a general worker is not routinely engaged in activities in this area.

Although the RME cancer risk estimate is slightly above the *de minimis* risk level (1×10^{-6}), it is within the acceptable regulatory risk range of 1×10^{-6} to 1×10^{-4} . Therefore, potential cancer risks are not significant for this scenario and residual chemicals do not pose an unacceptable risk.

Indoor Worker Scenario

The cancer risk estimates for the Indoor Worker Scenario range from 1×10^{-7} (MLE) to 1×10^{-6} (RME) (Table 6-6). Since the cancer risk estimates are equal to or less than the *de minimis* cancer risk level (1×10^{-6}), potential cancer risks are not significant for this scenario and residual chemicals do not pose an unacceptable risk.

6.2 Operable Unit 2

Operable Unit 2 is the former Air Force Plant 36 (Figure 2-2). Three exposure scenarios are evaluated for Operable Unit 2: (1) General Worker (Outdoor) Scenario, (2) Indoor Worker Scenario, and (3) Excavation Worker Scenario. The General Worker and Indoor Worker Scenarios are considered appropriate for Operable Unit 2 based on the fact that this area will remain an active industrial area into the foreseeable future. Because small-scale excavations may occur in the future, an Excavation Worker Scenario is also evaluated.

6.2.1 Noncancer Risk Estimates (Hazard Indices)

The chemical-specific and pathway-specific HIs for all Operable Unit 2 scenarios are presented in Tables 6-7 through 6-9 and are discussed below.

General Worker Scenario

The hazard indices for the General Worker Scenario range from 0.003 (MLE) to 0.06 (RME) (Table 6-7). Since the HIs are less than 1, potential noncancer hazards are not significant for this scenario and residual chemicals do not pose an unacceptable risk.

Indoor Worker Scenario

The hazard indices for the Indoor Worker Scenario range from 0.006 (MLE) to 0.01 (RME) (Table 6-8), indicating that potential noncancer hazards are not significant for this scenario and residual chemicals do not pose an unacceptable risk.

Excavation Worker Scenario

The hazard indices for the Excavation Worker Scenario range from 3 (MLE) to 90 (RME) (Table 6-9). Dermal contact with TPH in perched groundwater contributes more than 99% of each HI (Table 6-9). There are two reasons why the HIs may overstate risks and thus not be fully representative:

- (1) As discussed above, the most conservative value (Group 1) for the RfD for TPH (0.48 mg/kg-day) is used to derive the hazard quotients (MLE = 2.7, RME = 87). However, if the Group 2 or 3 RfD is used, the hazard quotients for dermal contact are 2.1 and 68 (Group 2) or 0.71 and 23 (Group 3) for the MLE and RME evaluations, respectively.
- (2) The RME HI is calculated using the maximum concentration (170,200 mg/L). It should be noted that the dataset for TPH consists of only two samples which report highly disparate results: 1.06 and 170,200 mg/L (Figure 6-2).

6.2.2 Cancer Risk Estimates

The chemical-specific and pathway-specific cancer risk estimates for all Operable Unit 2 scenarios are presented in Tables 6-10 through 6-12, and are discussed below.

General Worker Scenario

The cancer risk estimates for the General Worker Scenario range from 4×10^{-8} (MLE) to 6×10^{-8} (RME) (Table 6-10). Since the cancer risk estimates are less than the *de minimis* cancer risk level (1×10^{-6}), potential cancer risks are not significant for this scenario and residual chemicals do not pose an unacceptable risk.

Indoor Worker Scenario

The cancer risk estimates for the Indoor Worker Scenario range from 3×10^{-7} (MLE) to 2×10^{-6} (RME) (Table 6-11). The major contributors to the RME cancer risk estimate are inhalation of 1,1-dichloroethene, vinyl chloride, and trichloroethene (Table 6-11). It should be noted that EPA is in the process of reevaluating vinyl chloride and the slope factor is likely to be revised downward (USEPA, 1998). Although the RME cancer risk estimate is only slightly above the *de minimis* risk level (1×10^{-6}), it is within the acceptable regulatory risk range of 1×10^{-6} to 1×10^{-4} . Therefore, potential cancer risks are not significant for this scenario and residual chemicals do not pose an unacceptable risk.

Excavation Worker Scenario

The cancer risk estimates for the Excavation Worker Scenario range from 5×10^{-9} (MLE) to 3×10^{-7} (RME) (Table 6-12). Since the cancer risk estimates are less than the *de minimis* cancer risk level (1×10^{-6}), potential cancer risks are not significant for this scenario and residual chemicals do not pose an unacceptable risk.

6.3 Operable Unit 3

Operable Unit 3 consists of the inactive Reading Road Landfill, Sludge Basin Landfill, and East Landfarm (SWMUs 17-19) (Figure 2-2). Since GEAE leases property within this area to a farmer, a Resident Scenario is evaluated. As discussed in Section 5.0, no COIs are identified in OU3 soil based on a comparison to residential screening criteria (USEPA Region IX Preliminary Remediation Goals) (Table 5-4). As expected, concentrations of arsenic and beryllium at OU3 are above the PRGs, but they are within the range of Ohio farm background soil concentrations (see Section 3.4.3). Therefore, the only complete exposure pathway at OU3 is inhalation of airborne contaminants potentially transported from OU1 and OU2

6.3.1 Noncancer Risk Estimates (Hazard Indices)

The chemical-specific and pathway-specific HIs for the Resident Scenario are presented in Table 6-13. The hazard indices for the Resident Scenario range from 0.002 (RME) to 0.01 (MLE) (Table 6-13). Since the hazard indices are below 1, potential noncancer hazards are not significant for this scenario.

6.3.2 Cancer Risk Estimates

The chemical-specific and pathway-specific cancer risk estimates for the Resident Scenario are presented in Table 6-14. The cancer risk estimates for the Resident Scenario range from 9×10^{-7} (RME) to 1×10^{-6} (MLE) (Table 6-14). Since the risk estimates are equal to or less than the *de minimis* cancer risk level (1×10^{-6}), potential cancer risks are not significant for this scenario.

6.4 Operable Unit 4

Operable Unit 4 consists of the Lime Precipitation Basins (SWMUs 27-31) (Figure 2-2). Although this area is inactive, workers occasionally visit the area. Therefore, a General Worker Scenario is evaluated for Operable Unit 4.

6.4.1 Noncancer Risk Estimates (Hazard Indices)

The chemical-specific and pathway-specific HIs for the Operable Unit 4 General Worker Scenario are presented in Table 6-15. The hazard indices for the General Worker Scenario range from 0.03 (MLE) to 0.7 (RME) (Table 6-15). Since the hazard indices are below 1, potential noncancer hazards are not significant for this scenario and residual chemicals do not pose an unacceptable risk. Although lead is a chemical of interest that is elevated in Operable Unit 4 surface soil, potential health risks are not quantified since there are no toxicity values available. The dataset for lead in surface soil consists of only four samples: 3540, 331, 195, and 86 mg/kg. The maximum detected concentration is the only value which exceeds the PRG for industrial soil of 1,000 mg/kg (USEPA, 1996a). However, the mean concentration of lead is 1038 mg/kg. U.S. EPA (1994d) guidance on lead in residential soil states that interim controls (*e.g.*, restricting access, planting ground cover)

should be implemented to decrease contact by children with soil containing lead concentrations ranging from 2,000 to 5,000 mg/kg. However, since an adult does not have the same exposure to soil as a child does, concentrations falling within this range would be protective of an adult. Based on anticipated human exposures (adult) at this area and a mean lead concentration of 1038 mg/kg, lead is not anticipated to pose an unacceptable risk at Operable Unit 4 for the following reasons.

- (1) An adult worker is only expected to visit Operable Unit 4 occasionally.
- (2) Only one out of four detected concentrations (*i.e.*, the maximum detected concentration) is above the PRG (1000 mg/kg) for industrial soil.
- (3) The maximum detected concentration falls within the EPA residential guidance range of 2,000 to 5,000 mg/kg that indicates that access controls are needed. These controls are currently in place at OU4.

6.4.2 Cancer Risk Estimates

The chemical-specific and pathway-specific cancer risk estimates for the Operable Unit 4 General Worker Scenario are presented in Table 6-16. The cancer risk estimates for the General Worker Scenario range from 9×10^{-7} (MLE) to 1×10^{-4} (RME) (Table 6-16). Ingestion of and dermal contact with arsenic in surface soil contribute more than 99% of the RME cancer risk estimate (Table 6-16). The arsenic dataset consists of four samples: 230, 23, 14, and 1.8 mg/kg. Three out of four of these results fall within the background range of 0.5 to 56 mg/kg for arsenic in Ohio farm soil (Cox and Colvin, 1996). However, the RME cancer risk estimate is calculated using the maximum detected concentration (230 mg/kg) as the exposure point concentration. Using the mean arsenic concentration of 67 mg/kg, the RME risk estimate would be 3.5-fold less or 3×10^{-5} . It is unlikely that a worker would continuously contact only the maximum concentration. Additionally, although the RME cancer risk estimate is above the *de minimis* risk level (1×10^{-6}), it falls within the regulatory risk range of 1×10^{-6} to 1×10^{-4} . Therefore, potential cancer risks are not significant for this scenario.

6.5 Summary of Potential Health Risks

The noncancer (hazard quotient) and cancer risk estimates for the GEAE facility are summarized for OU1 through OU4.

Operable Unit 1

This HHRA demonstrates that potential noncancer and cancer risk estimates for the General Worker (Outdoor), Indoor Worker and Excavation Worker are not significant and residual chemicals in media do not pose an unacceptable risk for most of OU1. This HHRA also highlights the key chemicals of interest and areas within OU1 that may potentially pose a hazard if direct contact occurs on a daily basis for 25 years. These areas and their associated chemical concentrations account for

all risk estimates that exceed regulatory benchmarks for noncancer ($HQ > 1$) and cancer ($> 1E-06$) endpoints.

	<u>SWMU</u>	<u>Chemical</u>	<u>Pathway</u>
➤ Scrap & Salvage Yard Area	8/12	Aroclor 1248	Dermal/Ingestion-Soil
➤ O/W Separator 500-1	93/94	Benzene	Dermal-Sediment
➤ O/W Separator 500-2	95	Aroclor 1248	Dermal-Perched GW

Because RME exposure point concentrations for Aroclor 1248 (soil, groundwater) and benzene (sediment) result in using the maximum concentration, the only risk estimates for OU1 that result in values above regulatory benchmarks are at these locations. If a general worker (outdoor) or an excavation worker does not spend a considerable portion of his/her workday in these areas of interest over the RME exposure duration of 25 years, the risk estimates associated with an upper bound (RME) analysis are expected to be insignificant. All other chemicals and SWMUs within OU1 do not present a significant risk nor do residual chemical concentrations remaining in soil or groundwater (perched) pose an unacceptable risk.

Operable Unit 2

This HHRA demonstrates that potential noncancer and cancer risk estimates for the General Worker (Outdoor) in OU2 are not significant and residual chemicals in media do not pose an unacceptable risk. For the Indoor Worker, the noncancer and cancer risk estimates are not significant including the marginal excursion of the RME cancer risk estimate of $2E-06$. Although this value slightly exceeds the *de minimis* risk level ($1E-06$), the conservative nature of the upper bound (RME) evaluation and modeling predictions provide an adequate margin of safety to insure that there is no concern. Specific details regarding the conservative nature and uncertainty of the RME evaluation and modeling are described in Section 6.6 (Uncertainty Analysis). For the Excavation Worker, only one medium (groundwater) and chemical (TPH) is identified that potentially poses a noncancer hazard. All cancer risk estimates for the Excavation Worker are below the regulatory benchmark of $1E-06$. One area within OU2 and the associated chemical concentration for TPH accounted for the risk estimate that exceeded the regulatory benchmark for noncancer ($HQ > 1$) endpoint.

- SWMU 104/AOC G MW-13P TPH

Based on available data, no chemicals in soil are a concern for any of the exposure scenarios. All other chemicals and SWMUs within OU2 do not present a significant risk nor do residual chemical concentrations remaining in soil or groundwater (perched) pose an unacceptable risk.

Operable Unit 3

This HHRA evaluates potential exposures to a Resident only for OU 3. Based on a comparison of the maximum detected chemical concentrations in OU3 to USEPA (Region 9) risk-based screening

criteria for residential media, no chemical of concern were identified for the quantitative exposure assessment. The inhalation pathway was evaluated for the resident to characterize potential exposure to VOCs in ambient air that may be released from OU1 and OU2. All risk estimates for the resident inhalation pathway are below regulatory benchmarks and are not a concern. Therefore, all SWMUs within OU3 do not present a significant risk nor do residual chemical concentrations remaining in soil or groundwater (perched) pose an unacceptable risk. Although a worker (outdoor) scenario was not performed for OU3, the results for the residential scenario would indicate that exposures to potential workers are not a concern since exposure would occur to a relatively smaller degree based on exposure frequency and duration.

Operable Unit 4

This HHRA evaluates potential exposures to a General Worker (Outdoor) only for OU 4. The noncancer risk estimates for all chemicals in OU4 are below the regulatory benchmark and are not a concern. Lead is elevated at a single sample location within SWMU 29/30 at a concentration of 3,540 mg/kg. Although this concentration is above the Region 9 PRG of 1,000 mg/kg for nonresidential exposures, limited activity in this inactive portion of the GE property and access controls limit the nature and extent of potential exposures. The cancer risk estimates were *de minimis* (below 1E-06) for all chemicals and SWMUs except for arsenic in SWMU 29/30 at sample location 29_30-SS4. The maximum arsenic concentration of 230 mg/kg was used to evaluate the RME General Worker (Outdoor) for OU3. However, all other arsenic measurements were less than 23 mg/kg for other SWMUs comprising OU3. Therefore, the noncancer and cancer risk estimates are below regulatory benchmarks and residual chemical concentrations do not pose an unacceptable risk for all SWMUs within OU3 except for a single sample location (29_30-SS4) within SWMU 29/30.

6.6 Uncertainty Analysis

The purpose of this section is to identify and discuss areas of uncertainty associated with the quantitative estimates of risk presented in this assessment. This discussion serves to place the risk estimates in proper perspective by fully specifying the assumptions and uncertainties inherent in the assessment (USEPA, 1989a). The key variables and assumptions are identified that contribute most to the uncertainty. Since a highly quantitative analysis of uncertainty is beyond the scope of this assessment, this section presents a qualitative uncertainty analysis.

There are numerous sources of uncertainty inherent in the risk assessment process. Some degree of uncertainty is introduced into the assessment each time an assumption is made. Many assumptions have valid and strong scientific bases, whereas others are estimates usually represented by a range of values. Where there is uncertainty regarding an assumption, a conservative estimate is often chosen to ensure that the assessment will be health-protective.

6.6.1 Uncertainty in Site Characterization

Uncertainties are associated with the determination of past, current, and future land uses associated with the site and surrounding area as well as the exposure scenarios evaluated under these land uses. Detailed historical knowledge of the area cannot be known completely and, therefore, some uncertainty exists regarding what may have occurred in the study area in the past. The uncertainty associated with current land use determination (*i.e.*, baseline conditions) is deemed to be small since recent site visits and interviews with knowledgeable GEAE and community personnel were used to determine current land usage for the area. High confidence is placed in the assumption that the current land use for the site (*i.e.*, industrial) will persist into the future. The high degree of confidence placed in this assumption is based upon the fact that the site has been industrial for over 50 years, is currently in active use by one of the world's leading aircraft manufacturers, and GEAE has no plans to sell the site or convert it from active industrial use.

6.6.2 Uncertainty in Data Evaluation

A discussion of the uncertainties introduced by how RFI and post-RFI data are used to support the risk assessment is provided below.

- *Use of Estimated Concentrations* - USEPA (1989a) guidance conservatively recommends that estimated concentrations ("J" verified data) of chemicals in environmental media should be treated as detected concentrations for risk assessment purposes. The risk assessment data sets contained a number of estimated concentrations (see Section 3.0). Since estimated values are used to calculate the concentration term for COIs identified as key risk issues for the facility, the uncertainty associated with the use of estimated concentrations will contribute significantly to uncertainty in the risk estimates in some cases.
- *Use of Nondetect Data* - As recommended by USEPA guidance (1989a), nondetect results for chemicals detected in other samples from the same medium are included in the calculation of exposure concentrations using one-half the detection limit as an assumed concentration. It should be noted that in most cases a chemical present in site media at a concentration equal to half the detection limit would be detected at least qualitatively. As such, the concentration of the chemical could be estimated, receiving a "J" qualifier. For this reason, the use of one-half the detection limit for nondetect data is conservative since, if the COI is present at a concentration of one-half of its detection limit, it would most likely be "J"-qualified. In extreme cases, the practice of using one-half the detection limit for nondetects can result in the calculation of mean and UCL concentrations that exceed the maximum detected concentration. While the effect of combining nondetect data with non-qualified data (truly detected) is usually not severe, it may be significant in some cases. As such, hazard and risk estimates based on highly censored data sets (*i.e.*, infrequently detected chemicals) may be significantly overestimated.

- *Averaging of Sample Duplicates* - Consistent with USEPA guidance (USEPA, 1989f), the results from sample-duplicate pairs are combined (averaged) prior to calculating summary statistics. The average represents the best estimate of the "true" concentration. The net impact of averaging the sample-duplicate pairs serves to underestimate potential risks if the "true" sample concentration lies closer to the maximum result. On the other hand, if the true sample concentration lies closer to the minimum result, then the averaging of sample duplicate pairs serves to overestimate potential risks.
- *Characterization of COI Concentration Distributions* - COI distributions are characterized using the methodology of D'Agostino *et al.* (1990). This process utilizes statistics for skewness (asymmetry about the mean) and kurtosis (peakedness) to establish normality for a data set, and is used to determine which 95% UCL (normal or lognormal) to apply for the RME exposure point concentration. In general, the 95% UCL (calculated assuming lognormality) is larger than the 95% UCL (calculated assuming normality). This is particularly true when the sample size is small. Confidence in the results of the normality test is affected by both the total number of samples and the number of nondetects (evaluated using one-half the detection limit). Confidence is high when the sample number is large and the number of nondetects is small, while confidence is low when the converse is true.

To minimize the impact of sample size and nondetects on this process, distributions are not characterized when the total number of samples is less than eight or when the detection frequency is less than 50%. In these cases, lognormality is assumed as a default. However, in some cases the default assumption that chemical concentrations are lognormally distributed may be overly conservative. For example, a COI distribution that is determined to be non-normal due to deviations in kurtosis may actually behave more like a normal distribution than a lognormal distribution since it is not skewed; however, the lognormal 95% UCL would still be used in the risk assessment for RME scenarios. For this reason, uncertainty in the distribution characterization may significantly contribute to uncertainty in the final RME risk estimates and will tend to overestimate risks.

- *Chemicals Not Included in the Quantitative Risk Assessment* - A number of chemicals are eliminated from the quantitative risk assessment because they are detected at concentrations that are either similar to background or below health-based benchmarks. Chemicals are not eliminated based on detection frequency.

To address potential concerns associated with eliminating frequently detected chemicals as COIs because they are detected at concentrations that are only slightly below health-based benchmarks (*i.e.*, maximum concentration is greater than or equal to 90% of the benchmark), and ratio between the maximum detected concentration and the benchmark and the chemical's detection frequency are examined for chemicals that are eliminated by the health-based benchmark evaluations. The ratios for all chemicals eliminated by the health-based benchmark evaluations are below 63% (Table 6-17); therefore, the potential impact

of excluding chemicals from the risk assessment by using the health-based benchmark evaluation is small.

- *Data Not Included in the Quantitative Risk Assessment* - All RFI and post-RFI data are included in the risk assessment except when:
 - (1) direct exposure is not expected to occur to a specific media at the site (*i.e.*, upper and lower sand and gravel aquifer groundwater or subsurface soil); or
 - (2) nondetect concentrations for a specific chemical in a medium exceed the maximum detected concentration, as recommended by USEPA guidance (USEPA, 1989a).

Historical information is not used in this assessment since these data are not representative of current or future conditions in the study area. RFI and post-RFI data are considered adequate and more current and are, therefore, the focus of this risk assessment. As such, the uncertainty associated with the exclusion of historical data is considered small.

- *Biases in the RFI Sampling Program* - In general, the RFI and post-RFI sample locations were established with the purpose of locating and characterizing areas of suspected releases. As such, these samples are not randomly distributed throughout the study area and are instead highly biased. Data from these locations are more representative of potential "hot spots" than they are representative of overall conditions. For this reason, the use of these data for general exposure purposes may be viewed as conservative.

6.6.3 Uncertainty in Toxicity Assessment

A discussion of the uncertainties introduced by the toxicity values used in the risk assessment (*i.e.*, reference doses and slope factors) is provided below. It should be noted that several of the COIs at the site are chemicals that are either in the process of being reevaluated or will be reevaluated in 1998 by USEPA (1998). COIs which will be reevaluated by the Agency include three inorganic chemicals (arsenic, cadmium, and chromium) and six organic chemicals (benzene, naphthalene, PCBs, tetrachloroethene, trichloroethene, and vinyl chloride).

- *Reference Doses* - Toxicity information for many constituents is limited for humans, consequently, depending on the quality and extent of toxicity information, varying degrees of uncertainty is associated with the calculated toxicity values. The USEPA derives RfDs for chemicals of interest using an uncertainty factor approach. In general, the procedures used to extrapolate from animals to humans in toxicity studies include identification of a no-effect level for a sensitive parameter in a sensitive species and use of a conservative uncertainty factor (value of up to 10,000) to establish an RfD. Potential effects on humans are likely overestimated rather than underestimated since exceeding an RfD still places exposure 10-10,000 times below the level that had no effect on a sensitive animal species.

- *Slope Factors* - Cancer slope factors by definition are a "plausible upper bound estimate of the probability" of developing cancer per unit dose over a lifetime. Slope factors are generally derived by applying the linearized multistage (LMS) model to the dose-response data, regardless of the cancer mechanism of action. The LMS model is generally used by USEPA since it generates among the highest (and therefore most conservative) slope factor values compared to other models. There is a great deal of uncertainty associated with cancer slope factors, specifically regarding model selection and use of the upper confidence limits. For example, upper bound cancer risk estimates predicted using alternative models (*i.e.*, probit, Weibull, and one-hit) may be much lower than those predicted using the LMS model (USEPA, 1988a).

In addition to these sources of uncertainty, it is important to note that there have been recent changes to how cancer potency factors are derived, specifically regarding scaling approaches to calculating human equivalent doses, and methods for extrapolating results from high to low doses (USEPA, 1996g). For this reason, virtually all cancer slope factors available through IRIS and HEAST (with exception to the recently revised slope factors for PCBs) are based on outdated methodology and obsolete software (*i.e.*, Global79).

With respect to calculating human equivalent doses, the USEPA now recommends using a body weight scaling approach based on body weight ratio (raised to the 3/4 power) instead of a ratio based on surface area (body weight raised to the 2/3 power) (USEPA, 1992b). Although this change has no impact on cancer slope factors based on human studies (*i.e.*, arsenic), it does have a significant impact on the cancer slope factors based on animal studies. The degree to which this impacts the resulting slope factor is dependent upon the body weight of the test species. Body weight scaling conversion factors (2/3 to 3/4) can be calculated using the following formula:

$$ConversionFactor = \frac{(70 / BW)^{1/4}}{(70 / BW)^{1/3}}$$

Where BW = Body weight of the test species

Using this formula, correction factors of 0.64, 0.60, and 0.52 can be calculated for cancer slope factors based on studies using rats (assuming a body weight of 0.35 kg), hamsters (assuming a body weight of 0.14 kg), and mice (assuming a body weight of 0.03 kg), respectively. Based on these correction factors, unadjusted, existing cancer slope factors over-predict cancer risk by 36%, 40%, and 48%, respectively. Other changes in the cancer risk assessment guidelines (USEPA, 1996g) also serve to decrease the existing cancer slope factor values, however, the degree is much less than that noted for the changes in body weight scaling.

- When provisional or surrogate values cannot be identified, uncertainty in the HIs and cancer risk estimates can arise from the lack of a toxicity value for a COI. In this assessment, RfDs and slope factors are available for all chemicals except the following:

- As such, the potential hazards and risk associated with exposures to these chemicals remain a source of uncertainty in the HHRA and suggest that the total HIs and cancer risk estimates may be underestimated.

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absorption than the gastrointestinal tract for a number of reasons, exposure via the skin would generally present less of a risk than the corresponding oral exposure. The use of oral slope factors in these scenarios represents a conservative approach to evaluating risk from dermal exposure.

An exception to this approach is the treatment of PAHs for which no dermal slope factors are derived from oral slope factors in accordance with Agency guidance. This guidance indicates that the point-of-contact nature of the forestomach tumors upon which the oral slope factors are based make it inappropriate to use them for dermal cancer risk assessment. The absence of putative dermal potency factors for these compounds in the risk assessments in which dermal contact occurs (soils/spoils, surface water and sediment) thus represents an uncertainty in the assessment. Since PAHs are known to cause skin tumors in animal skin painting experiments, have been associated with human cancers, and have the potential to be absorbed across the skin, this may represent an underestimate of the total risk for exposure scenarios involving dermal contact with carcinogenic PAHs. Fortunately, the relatively low concentrations detected, the soil-binding characteristics of this class of compounds, and the barrier function of the skin probably prevent a significant exposure through this route.

6.6.4 Uncertainty in Exposure Assessment

A discussion of the uncertainties introduced by the selection of exposure parameter values used in the HHRA is provided below.

- *Exposure Frequency* - Conservative default values are used for the worker (250 days/year) and resident scenarios (350 days/year).
- *Degradation* - The HHRA assumes no degradative processes that may decrease chemical concentrations over time resulting in an overestimate of exposure for at least organic compounds. This assumption serves to overestimate potential hazards and risks in the future, particularly for compounds that are relatively short-lived.
- *Bioavailability* - In general, the HHRA looks at bioavailability in two ways: (1) dermal absorption from solids and water, and (2) gastrointestinal absorption. Dermal absorption from water is based on the permeability constant, K_p , of the COI in question and time in contact with the water. K_p values are either literature values or derived via procedures laid out in USEPA's Dermal Absorption Assessment (USEPA, 1992a). These estimated values are likely to overestimate systemic absorption based on comparison with actual data.

Dermal absorption of COIs from soil is assumed to be a percentage of the concentration contained in the amount adhering to skin, and this percentage varies with the class of chemical. For instance, only 1% of inorganics from the solid matrix is assumed to be absorbed while 10% of semi-volatile organics and 25% of volatile organics is assumed to be absorbed unless other literature values existed. These values are considered overestimates

of the actual absorption and hence dose. Metals in soil are only poorly absorbed if at all, and typically the absorbed material is retained in the epidermal layer from which it is sloughed off along with the skin. The absorption of organics is overestimated as a result of ignoring two factors: contact time and aging. The absorption of organics from soil and across skin is time dependent. There is a significant lag time in between the point of soil contact and systemic absorption of the COI(s). In fact, this lag time is generally longer than the soil remains in contact with the skin. Thus it is likely that no significant systemic absorption occurs before the soil is removed, and the majority of what is absorbed remains trapped in the epidermis and is sloughed off with the skin before it reaches the systemic circulation.

Another issue that is ignored is aging of organic (and inorganic) residues in soil over time. It has been demonstrated for various compounds that their chemical and biological availability in soil decreases over time. It is assumed that changes in the chemical-soil system over time results in a decrease in bioavailability. Aged soil residues, therefore, are not as well absorbed through skin (or other biological membrane) as fresh soil residues, which are in turn not as well absorbed as the pure compound.

The dermal absorption of Aroclor-1248 is specifically examined since it is an important contributor to risk estimates at the site. According to USEPA guidance (1992a), the absorption factor (ABS) for PCBs ranges from 0.006 to 0.06. In this assessment, an ABS of 0.06 is conservatively used. However, if the lower ABS value of 0.006 is used, HIs and cancer risk estimates for dermal absorption of Aroclor-1248 would decrease by an order of magnitude.

The gastrointestinal absorption of COIs is assumed to be equivalent to that achieved in the toxicological studies used to derive the toxicity values (RfDs, slope factors). Use of this default assumption probably leads to an overestimate of the systemic absorption of aged, soil-bound COIs since researchers generally make efforts to ensure as much of the test compound is absorbed in the toxicological studies as possible (*i.e.*, administration in oil gavage). In addition, the amount of soil ingested and the exposure and frequency durations are conservative values and will result in an overestimate of the absorbed dose.

- *Modeling* – Like most model simulations of environmental processes/phenomena, many assumptions have to be made due to the uncertain nature of the fate and transport processes and the lack of data needed to support and/or verify some of the modeling assumptions. This section discusses qualitatively the uncertainty created by the various modeling assumptions. Each of the following subsections discusses the uncertainties associated with each of the major model assumptions and their possible effects on the estimated vapor emission fluxes, air concentrations, and PEF calculations.

Sources of uncertainty related to the modeling vapor fluxes from soil and groundwater are as follows:

- ***Soil is homogeneous in nature.*** It is well known that soil is heterogeneous in nature, not homogeneous. However, for most fate and transport models, especially analytical models such as BAM, soils are assumed to be homogeneous in order to simplify the calculations. The soil properties at the GEAE Evendale facility are assumed to be the same throughout the area. In general, the use of uniform soil properties for large areas of a site will lead to an overestimation of vapor flux, especially considering the conservative USEPA default values for soil parameters used in this modeling effort. The site conditions are likely to be markedly different than those presented in this assessment. The soil porosity values used in this modeling effort, including percent air filled and percent water filled, may be specifically deemed as driving the calculation of fluxes higher than would be expected at the site given actual soil parameterization.
- ***Chemicals behave according to the linear equilibrium sorption isotherm for solid-liquid partitioning.*** Sorption of chemicals to soil has been studied in depth for a few chemicals and does not necessarily behave in a linear fashion. The effects of nonlinear adsorption on the vapor emission flux will depend on the concentration of the chemical partitioning between the solid and liquid phases. For low concentrations, nonlinear and linear adsorption isotherms will produce similar results. As concentration in both phases increases, adsorption sites become saturated and the mass of chemical that partitions to the solid phase decreases. Because partitioning of the VOCs in soil occurs primarily in soils above the water table that are assumed to contain low concentrations of VOCs, the effects of nonlinear adsorption are minimal.
- ***There is a uniform chemical concentration in the soil at time $t = 0$ between the depths z_1 (ground surface) and z_2 .*** There is a moderate degree of uncertainty associated with this assumption. This variable can have a significant effect on the output of the model. Chemicals tend to be located in a staggered fashion, in "pockets", at a site. The extension of the chemical source to include the entire soil column adds to the overestimation of the amount of chemical available to volatilize. The source term becomes more persistent as a result. The uncertainty related to this assumption typically leads to overestimation of the vapor emissions from soil.
- ***The vapor emission model assumes that the groundwater concentration of the chemical is uniform throughout the volume of the aquifer and does not vary with time.*** The use of this assumption for groundwater concentration is conservative and will lead to an overestimation of the vapor flux of VOCs from surface soils if there are any significant changes in on-site groundwater concentrations over time due to advective transport or degradation processes. Because of the natural variability in groundwater concentrations, it is unlikely that the chemical concentrations within are uniform. However, this assumption is necessary in order to simplify the calculation of vapor

emission flux. Use of refined area designations would diminish the effect of this assumption.

- ***The vapor emission model assumes that the depth to groundwater is uniform within each operational unit and does not vary with time.*** Similar to groundwater concentration, it is unlikely that the depth to groundwater will not vary with time due to the natural variability and the expected seasonal variability of groundwater elevations. However, the assumption that the depth to groundwater within each operating unit for a given point in time is uniform is not as significant an assumption of uniform groundwater concentration. Depending on how groundwater elevation changes in the operating units beneath the site, this assumption may lead to either an under- or over-estimation of vapor flux. The vapor flux prediction in this assessment was likely overestimated since the entire groundwater table depth was conservatively assumed to be 4 ft. below surface.
- ***Other than volatilization, no other degradation process was considered.*** Because most of the VOCs of interest are known to degrade over time due to other fate processes (biodegradation, hydrolysis, etc.) this assumption is conservative. As stated earlier, this assumption may lead to an overestimation of vapor flux depending on the site-specific likelihood of the different degradation processes.
- ***The vapor emission modeling assumed that the soil concentrations of VOC in the unsaturated zone are negligible.*** It is uncertain what effect this assumption has on the vapor flux estimates. If soil concentrations are truly negligible, vapor emission fluxes will be higher due to increased diffusion through the soil layer due to the concentration gradient. However, if soil concentrations are not truly negligible, the mass of VOCs in soil emitting from soil above groundwater may be larger than the decrease in the diffusion of chemicals from groundwater through soil due to the lower concentration gradient.
- ***The vapor emission modeling assumed that the diffusion of solute through the aquifer and overlying soils is instantaneous when, in reality, significant retardation may occur due to the slower diffusion rate.*** Once again, this is a simplifying assumption that will lead to an over-estimation of the time-averaged soil vapor flux. However, given the high Henry's Law constants and low organic carbon partitioning coefficients of some of the VOCs of interest, it is unlikely that significant retardation is occurring.

Sources of uncertainty related to air dispersion modeling using the ISC ST3 model are as follows:

- ***The use of five years of meteorological data to estimate air dispersion at the site.*** Since the variability in annual meteorological data from year to year is small, the effect on the estimated air concentrations will be small. However, this follows ISC ST3 Users

Manual Guidance. This assumption may under- or over-estimate concentrations at the receptor locations.

- ***The necessity to overestimate the source areas of the site due to constraints on area source geometry.*** The uncertainty related to this assumption is moderate. Since the source areas define the magnitude of emissions, variations in source areas may have a large effect on the final output of the model. Since the source areas were conservatively chosen, this might lead to an overestimation of air concentrations at the receptor locations.
- ***The location of receptors at 100 meter spacing.*** This has an element of moderate uncertainty associated with it. This will have a minimal effect on final output as the dispersion factors are averaged over the various receptors in an area.
- ***The site is modeled as having no terrain or building effects to dispersion.*** The presence of structures and geological terrain variations would effect the dispersion of vapors over the area. This assumption tends to over- and under-estimate air concentrations at the receptor locations depending on its proximity to the source of volatilization and the structures that may or may not separate the source from the receptor.

Sources of uncertainty related to the Indoor Mass-Balance Box Model air dispersion modeling using the ISC ST3 model are as follows:

- ***The Indoor Mass-Balance Box Model is a highly simplified approach and does not consider all the dispersion processes involved.*** This assumption can have a moderate effect on the final output of the model. Since this model does not account for all dispersion processes, this approach is considered very conservative.
- ***The assumption that the crack factor is 0.1% of the total floor area in calculating emissions inside the buildings.*** This is a very conservative assumption and can result in over-prediction of air concentration of a chemical inside the building. Hence, the indoor vapor concentration may be over-estimated by the using this assumption.
- ***The variability inherent in the assumption that the air exchange rates for building will be once every hour.*** This assumption may lead to an over- or under-estimation of the air concentrations in the buildings. There is a moderate degree of uncertainty involved with this assumption as the air exchange rate does not vary much from the number used. This assumption can have a moderate effect on the final output.

Sources of uncertainty related to calculation of particulate emission modeling are as follows:

- ***Use of Huntington Q/C dispersion term.*** There is a large degree of uncertainty in this assumption. The use of this value was considered to be the best available given the

screening level of effort for particulate modeling. As stated previously the regions of Evendale and Huntington are similar in many respects. This assumption may lead to under- or over-estimation of the PEF term.

- ***The source areas used in the PEF comparison are overestimated.*** There is a moderate to high degree of uncertainty in this assumption. Given the presence of building and pavement on the site, the source area was estimated by visual inspection. This allocation of available uncovered source area for particulate emissions attempted to err on the side of conservatism. In addition, the entire source area of a construction site was used in the calculation of PEFs for the construction scenario. This assumption tends to lead to overestimation of the PEF term.
- ***The construction scenario is theoretical.*** There is a large degree of uncertainty in this assumption. Since no data is available detailing a construction scenario at the GEAE Evendale site, the parameters for calculation of a construction/excavation PEF used default values and professional judgements. The PEF term of a larger scale excavation than 10,000 m² may be underestimated in this evaluation. The PEF term of a smaller scale excavation may be overestimated. It should be noted that the construction activity modeled in this assessment is quite rigorous in terms of vehicles used and activities performed. It may be possible that a larger construction project with less equipment or less soil movement would still be less than the final PEF value calculated in this assessment.

6.6.5 Uncertainty in Risk Characterization

A discussion of the uncertainties introduced by how the hazards and risks are characterized in the HHRA is provided below.

- ***Potential for Synergistic and Antagonistic Effects*** - In the HHRA, the potential for noncancer and cancer health risks is evaluated assuming additivity across COIs and exposure pathways. This practice ignores possible synergisms or antagonisms which may exist between chemicals in the mixture which may affect the absorption, metabolism (metabolic activation or detoxification), and ultimately the net toxicity of the mixture. It also ignores the possibility that there may be no interaction at all if the compounds have different sites of action and endpoints. For example, lead is actively absorbed in the gastrointestinal tract by the same transport system that absorbs other inorganic ions. Therefore, the absorption, and hence toxicity, of lead and possibly other metals may be significantly decreased by exposure to high concentrations of calcium (Hsu *et al.*, 1974), phosphate (Baltrop and Khoo, 1975), iron (Six and Goyer, 1972), zinc (Cerklewski and Forbes, 1975), copper (Klauder and Petering, 1975) and vice versa (*i.e.*, one may act as a competitive antagonist to the other). Aroclors and similar compounds stimulate the activity of microsomal enzymes and will increase their own biotransformation as well as that of other exogenous and endogenous

compounds. The resultant biological effects will depend on whether this biotransformation increases or decreases toxicity.

The assessment of risk from exposures to chemical mixtures is very complicated and requires an enormous amount of information that is not currently available. While the assumption of additivity may not always be a conservative assumption in risk assessment, exposure to very low doses of compounds with similar modes of action or target organs is more likely to approximate additivity than synergism, potentiation, or antagonism. Exposure to very low doses of compounds with dissimilar modes of action or target organs may result in no interaction and no apparent effect. Assuming that all COIs act in a direct additive manner would generally be considered a conservative approach. If the mixtures of chemicals present in site media truly produce synergistic effects, then the approach used in the risk assessment underestimates the potential health hazards. On the other hand, if the site chemicals in these mixtures act independently or antagonistically, the approach used in the risk assessment overestimates potential health hazards.

- *Compounded Uncertainties* - The risk estimates presented in the HHRA result from an integration of chemical, analytical, environmental, demographic, and toxicological data that vary with regards to site-specificity. All of the uncertainties in the site characterization, data evaluation, exposure assessment, and toxicity assessment ultimately impact the risk characterization. To minimize the effects of uncertainties on the evaluation, each step is biased toward conservative (*i.e.*, protective) estimations. Because each step builds on the previous one, this biased approach should more than compensate for these uncertainties and result in over- rather than underestimates of risk to potential receptors.
- *Summation Across Multiple Exposure Pathways* - In the HHRA, the hazard indices and cancer risk estimates from all complete exposure pathways (as many as 5 or 6) for a particular scenario are conservatively summed, a practice which is likely to overestimate hazards and risks. For some media combinations, consistent and repeated exposures to RME conditions does not appear to be a reasonable assumption. This may be the case for soil exposures vs. sediment and groundwater exposures, as evaluated in the HHRA. For example, an excavation worker may not come into contact with sediment and groundwater as frequently as with soil, thereby decreasing exposure to these media and lowering potential health risks.

TABLE 6-1
OPERABLE UNIT 1:
SUMMARY OF HIs FOR A GENERAL WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Ambient Air	Surface Soil		Chemical-Specific		% of Total
	Inhalation	Oral	Inhalation	Dermal	Subtotal	
MLE HI Estimates						
Aroclor-1248		1.4E-01	5.1E-08	4.1E-01	5.5E-01	91.7%
Manganese		3.0E-02	3.6E-05	NA	3.0E-02	5.0%
Total Petroleum Hydrocarbons		1.4E-03	2.0E-09	1.6E-02	1.7E-02	2.8%
Vinyl Chloride	2.3E-03				2.3E-03	0.4%
Trichloroethene	8.7E-05	1.1E-05	7.9E-15	1.3E-04	2.3E-04	0.0%
Benzene	1.9E-04				1.9E-04	0.0%
Benzo(a)Pyrene		1.2E-07	4.2E-14	5.3E-07	6.5E-07	0.0%
Pathway-Specific Subtotal	2.6E-03	1.7E-01	3.6E-05	4.3E-01	6E-01	100.0%
% of Total	0.4%	28.9%	0.0%	70.6%	100.0%	
RME HI Estimates						
Aroclor-1248		9.5E+00	9.1E-07	5.5E+01	6.4E+01	97.5%
Total Petroleum Hydrocarbons		4.7E-02	1.8E-08	1.1E+00	1.1E+00	1.7%
Manganese		5.1E-01	1.6E-04	NA	5.1E-01	0.8%
Trichloroethene	2.6E-05	5.7E-04	1.0E-13	1.3E-02	1.3E-02	0.0%
Vinyl Chloride	5.7E-04				5.7E-04	0.0%
Benzene	6.0E-05				6.0E-05	0.0%
o(a)Pyrene		5.9E-06	5.6E-13	5.3E-05	5.9E-05	0.0%
Pathway-Specific Subtotal	6.6E-04	1.0E+01	1.6E-04	5.6E+01	7E+01	100.0%
% of Total	0.0%	15.3%	0.0%	84.7%	100.0%	

NA Not applicable.

TABLE 6-2
OPERABLE UNIT 1:
SUMMARY OF HIs FOR AN EXCAVATION WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Perched Groundwater	Total Soil			Sediment		Chemical-Specific	
	Dermal	Oral	Inhalation	Dermal	Oral	Dermal	Subtotal	% of Total
MLE HI Estimates								
Benzene	5.6E-04				1.3E-03	1.5E-02	1.7E-02	36.5%
Manganese		8.2E-05	1.3E-02	NA			1.3E-02	28.4%
Aroclor-1248	1.1E-02	1.0E-04	5.0E-06	3.0E-04			1.2E-02	25.3%
Total Petroleum Hydrocarbons	1.8E-03	4.8E-06	9.2E-07	5.4E-05			1.8E-03	3.9%
Trichloroethene	1.7E-03	4.1E-07	3.8E-11	4.7E-06			1.7E-03	3.5%
Vinyl Chloride	5.3E-04	1.2E-06	7.7E-10	1.5E-05			5.5E-04	1.2%
Aroclor-1254		3.3E-05	1.6E-06	9.5E-05			1.3E-04	0.3%
Aroclor-1260		3.0E-05	1.5E-06	8.7E-05			1.2E-04	0.3%
Nickel	1.5E-05	5.2E-06	2.5E-07	4.7E-05			6.8E-05	0.1%
Ethylbenzene					4.1E-06	5.7E-05	6.1E-05	0.1%
Bis(2-Ethylhexyl)Phthalate	3.4E-05						3.4E-05	0.1%
Aroclor-1242	2.7E-05						2.7E-05	0.1%
Trichloroethane, 1,1,1-	2.5E-05						2.5E-05	0.1%
Xylenes					1.5E-06	1.7E-05	1.9E-05	0.0%
Tetrachloroethene	1.7E-05						1.7E-05	0.0%
Toluene					9.3E-07	1.1E-05	1.1E-05	0.0%
Dichloroethene, 1,2-	1.1E-05						1.1E-05	0.0%
Arsenic	7.7E-06						7.7E-06	0.0%
Dichloroethene, 1,1-	2.6E-06						2.6E-06	0.0%
Chromium	2.3E-06						2.3E-06	0.0%
N-Nitrosodiphenylamine	1.4E-06						1.4E-06	0.0%
Trichloroethane, 1,1,2-	5.1E-07						5.1E-07	0.0%
Dichloroethene, Cis-1,2-	4.9E-07						4.9E-07	0.0%
Dichloroethane, 1,2-	4.7E-07						4.7E-07	0.0%
Benzo(b)Fluoranthene		3.7E-09	1.8E-10	1.7E-08			2.1E-08	0.0%
Benzo(a)Anthracene		2.9E-09	1.4E-10	1.3E-08			1.6E-08	0.0%
enzo(a)Pyrene		2.6E-09	1.2E-10	1.2E-08			1.4E-08	0.0%
inyl Acetate	1.4E-08						1.4E-08	0.0%
Pathway-Specific Subtotal	1.6E-02	2.6E-04	1.3E-02	6.0E-04	1.4E-03	1.5E-02	5E-02	100.0%
% of Total	34.4%	0.6%	28.2%	1.3%	2.9%	32.7%	100.0%	
RME HI Estimates								
Benzene	1.4E-02				1.1E-01	2.4E+00	2.5E+00	59.0%
Aroclor-1248	1.4E+00	3.8E-03	4.9E-05	2.2E-02			1.4E+00	33.3%
Total Petroleum Hydrocarbons	1.1E-01	1.0E-04	5.2E-06	2.3E-03			1.2E-01	2.7%
Manganese		2.6E-03	1.1E-01	NA			1.2E-01	2.7%
Trichloroethene	5.1E-02	9.2E-05	2.3E-09	2.1E-03			5.3E-02	1.2%
Vinyl Chloride	9.1E-03	2.8E-05	4.9E-09	7.2E-04			9.9E-03	0.2%
Ethylbenzene					3.3E-04	9.1E-03	9.4E-03	0.2%
Aroclor-1254		9.0E-04	1.2E-05	5.1E-03			6.1E-03	0.1%
Nickel	2.8E-03	1.6E-04	2.0E-06	2.9E-03			5.9E-03	0.1%
Aroclor-1260		8.2E-04	1.0E-05	4.7E-03			5.5E-03	0.1%
Bis(2-Ethylhexyl)Phthalate	3.1E-03						3.1E-03	0.1%
Xylenes					1.2E-04	2.8E-03	2.9E-03	0.1%
Toluene					7.4E-05	1.7E-03	1.8E-03	0.0%
Aroclor-1242	1.6E-03						1.6E-03	0.0%
Arsenic	9.2E-04						9.2E-04	0.0%
Trichloroethane, 1,1,1-	7.0E-04						7.0E-04	0.0%
Chromium	4.6E-04						4.6E-04	0.0%
Dichloroethene, 1,2-	3.5E-04						3.5E-04	0.0%
Tetrachloroethene	2.8E-04						2.8E-04	0.0%
Dichloroethene, 1,1-	5.9E-05						5.9E-05	0.0%
N-Nitrosodiphenylamine	2.8E-05						2.8E-05	0.0%
Dichloroethene, Cis-1,2-	2.3E-05						2.3E-05	0.0%
Trichloroethane, 1,1,2-	8.2E-06						8.2E-06	0.0%
Dichloroethane, 1,2-	7.5E-06						7.5E-06	0.0%
Benzo(b)Fluoranthene		8.0E-08	1.0E-09	7.2E-07			8.0E-07	0.0%
Benzo(a)Anthracene		6.4E-08	8.3E-10	5.9E-07			6.5E-07	0.0%
lenzo(a)Pyrene		5.8E-08	7.4E-10	5.2E-07			5.8E-07	0.0%
/inyl Acetate	4.4E-07						4.4E-07	0.0%
Pathway-Specific Subtotal	1.6E+00	8.5E-03	1.1E-01	4.0E-02	1.1E-01	2.4E+00	4E+00	100.0%
% of Total	37.3%	0.2%	2.6%	0.9%	2.5%	56.5%	100.0%	

NA Not applicable.

TABLE 6-3
OPERABLE UNIT 1:
SUMMARY OF HIs FOR AN INDOOR WORKER
GEAE EVENDALE
(Page 1 of 1)

	Indoor Air	
Chemical	Inhalation	% of Total
MLE HI Estimates		
Vinyl Chloride	2.9E-03	48.0%
Dichloroethene, 1,2-	1.2E-03	19.3%
Benzene	5.6E-04	9.3%
Trichloroethane, 1,1,1-	5.3E-04	8.7%
Dichloroethane, 1,2-	4.1E-04	6.8%
Dichloroethene, 1,1-	3.5E-04	5.8%
Dichloroethene, Cis-1,2-	5.4E-05	0.9%
Vinyl Acetate	3.8E-05	0.6%
Tetrachloroethene	2.2E-05	0.4%
Trichloroethene	8.5E-06	0.1%
Trichloroethane, 1,1,2-	4.8E-06	0.1%
Pathway-Specific Subtotal	6E-03	100.0%
% of Total	100.0%	
RME HI Estimates		
Vinyl Chloride	3.9E-03	43.9%
Dichloroethene, 1,2-	1.6E-03	17.8%
Benzene	7.6E-04	8.6%
Dichloroethene, Cis-1,2-	7.3E-04	8.3%
Trichloroethane, 1,1,1-	7.1E-04	8.0%
Dichloroethane, 1,2-	5.6E-04	6.3%
Dichloroethene, 1,1-	4.7E-04	5.3%
Trichloroethane, 1,1,2-	6.7E-05	0.8%
Vinyl Acetate	5.2E-05	0.6%
Tetrachloroethene	2.9E-05	0.3%
Trichloroethene	1.1E-05	0.1%
Pathway-Specific Subtotal	9E-03	100.0%
% of Total	100.0%	

TABLE 6-4
OPERABLE UNIT 1:
SUMMARY OF RISK FOR A GENERAL WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Ambient Air	Surface Soil		Chemical-Specific		% of Total
	Inhalation	Oral	Inhalation	Dermal	Subtotal	
MLE Risk Estimates						
Aroclor-1248		8.6E-07	3.1E-13	2.5E-06	3.3E-06	94.9%
Trichloroethene	9.7E-08	4.5E-11	8.8E-18	5.2E-10	9.7E-08	2.8%
Vinyl Chloride	6.3E-08				6.3E-08	1.8%
Benzo(a)Pyrene		1.5E-08	4.6E-15	NA	1.5E-08	0.4%
Benzene	5.6E-10				5.6E-10	0.0%
Manganese						
Total Petroleum Hydrocarbons						
Pathway-Specific Subtotal	1.6E-07	8.7E-07	3.1E-13	2.5E-06	3E-06	100.0%
% of Total	4.6%	25.0%	0.0%	70.4%	100.0%	
RME Risk Estimates						
Aroclor-1248		1.4E-04	1.3E-11	7.8E-04	9.2E-04	99.9%
Trichloroethene	1.7E-07	1.3E-08	6.9E-16	3.0E-07	4.9E-07	0.1%
Benzo(a)Pyrene		4.6E-07	3.7E-14	NA	4.6E-07	0.0%
Vinyl Chloride	9.1E-08				9.1E-08	0.0%
Benzene	1.1E-09				1.1E-09	0.0%
Manganese						
Total Petroleum Hydrocarbons						
Pathway-Specific Subtotal	2.7E-07	1.4E-04	1.3E-11	7.8E-04	9E-04	100.0%
% of Total	0.0%	14.9%	0.0%	85.1%	100.0%	

NA Not applicable.

TABLE 6-5
OPERABLE UNIT 1:
SUMMARY OF RISK FOR AN EXCAVATION WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Perched Groundwater	Total Soil			Sediment		Chemical-Specific	
	Dermal	Oral	Inhalation	Dermal	Oral	Dermal	Subtotal	% of Total
MLE Risk Estimates								
Aroclor-1248	1.6E-08	1.5E-10	7.1E-12	4.2E-10	1.7E-10	1.9E-09	1.7E-08	73.2%
Benzene	7.0E-11						2.1E-09	9.2%
Trichloroethene	1.6E-09	3.9E-13	1.0E-14	4.4E-12			1.6E-09	6.7%
Tetrachloroethene	1.3E-09						1.3E-09	5.5%
Vinyl Chloride	2.9E-10	6.5E-13	4.9E-15	8.2E-12			3.0E-10	1.3%
Dichloroethene, 1,1-	2.0E-10						2.0E-10	0.9%
Aroclor-1254		4.7E-11	2.3E-12	1.4E-10			1.8E-10	0.8%
Aroclor-1260		4.3E-11	2.1E-12	1.2E-10			1.7E-10	0.7%
Bis(2-Ethylhexyl)Phthalate	1.4E-10						1.4E-10	0.6%
Benzo(a)Pyrene		8.1E-11	3.3E-12	NA			8.4E-11	0.4%
Aroclor-1242	5.4E-11						5.4E-11	0.2%
Arsenic	5.0E-11						5.0E-11	0.2%
Dichloroethane, 1,2-	1.8E-11						1.8E-11	0.1%
Trichloroethane, 1,1,2-	1.7E-11						1.7E-11	0.1%
Benzo(b)Fluoranthene		1.2E-11	4.7E-13	NA			1.2E-11	0.1%
Benzo(a)Anthracene		9.1E-12	3.7E-13	NA			9.5E-12	0.0%
N-Nitrosodiphenylamine	1.9E-12						1.9E-12	0.0%
Chromium								
Dichloroethene, 1,2-								
Dichloroethene, Cis-1,2-								
Ethylbenzene								
Manganese								
Nickel								
Toluene								
Total Petroleum Hydrocarbons								
Trichloroethane, 1,1,1-								
Vinyl Acetate								
Xylenes								
Pathway-Specific Subtotal	2.0E-08	3.4E-10	1.6E-11	6.9E-10	1.7E-10	1.9E-09	2E-08	100.0%
% of Total	86.6%	1.5%	0.1%	3.0%	0.7%	8.2%	100.0%	
RMB Risk Estimates								
Aroclor-1248	2.0E-06	5.4E-09	7.0E-11	3.1E-08	1.3E-08	3.0E-07	2.1E-06	82.4%
Benzene	1.7E-09						3.2E-07	12.7%
Trichloroethene	4.8E-08	8.7E-11	6.1E-13	2.0E-09			5.0E-08	2.0%
Tetrachloroethene	2.1E-08						2.1E-08	0.8%
Bis(2-Ethylhexyl)Phthalate	1.2E-08						1.2E-08	0.5%
Aroclor-1254		1.3E-09	1.6E-11	7.4E-09			8.7E-09	0.3%
Aroclor-1260		1.2E-09	1.5E-11	6.7E-09			7.9E-09	0.3%
Arsenic	5.9E-09						5.9E-09	0.2%
Vinyl Chloride	5.0E-09	1.5E-11	3.1E-14	3.9E-10			5.4E-09	0.2%
Dichloroethene, 1,1-	4.5E-09						4.5E-09	0.2%
Aroclor-1242	3.1E-09						3.1E-09	0.1%
Benzo(a)Pyrene		1.8E-09	1.9E-11	NA			1.8E-09	0.1%
Dichloroethane, 1,2-	2.9E-10						2.9E-10	0.0%
Trichloroethane, 1,1,2-	2.7E-10						2.7E-10	0.0%
Benzo(b)Fluoranthene		2.5E-10	2.7E-12	NA			2.5E-10	0.0%
Benzo(a)Anthracene		2.0E-10	2.2E-12	NA			2.0E-10	0.0%
N-Nitrosodiphenylamine	3.9E-11						3.9E-11	0.0%
Chromium								
Dichloroethene, 1,2-								
Dichloroethene, Cis-1,2-								
Ethylbenzene								
Manganese								
Nickel								
Toluene								
Total Petroleum Hydrocarbons								
Trichloroethane, 1,1,1-								
Vinyl Acetate								
Xylenes								
Pathway-Specific Subtotal	2.1E-06	1.0E-08	1.3E-10	4.8E-08	1.3E-08	3.0E-07	2E-06	100.0%
% of Total	85.0%	0.4%	0.0%	1.9%	0.5%	12.1%	100.0%	

NA Not applicable.

TABLE 6-6
OPERABLE UNIT 1:
SUMMARY OF RISK FOR AN INDOOR WORKER
GEAE EVENDALE
(Page 1 of 1)

	Indoor Air	
Chemical	Inhalation	% of Total
MLE Risk Estimates		
Vinyl Chloride	7.9E-08	61.8%
Dichloroethene, 1,1-	3.3E-08	26.2%
Trichloroethene	9.5E-09	7.5%
Dichloroethane, 1,2-	3.2E-09	2.5%
Benzene	1.7E-09	1.3%
Trichloroethane, 1,1,2-	6.4E-10	0.5%
Tetrachloroethene	2.9E-10	0.2%
Dichloroethene, 1,2-		
Dichloroethene, Cis-1,2-		
Trichloroethane, 1,1,1-		
Vinyl Acetate		
Pathway-Specific Subtotal	1E-07	100.0%
% of Total	100.0%	
RME Risk Estimates		
Vinyl Chloride	6.2E-07	61.7%
Dichloroethene, 1,1-	2.7E-07	26.2%
Trichloroethene	7.6E-08	7.5%
Dichloroethane, 1,2-	2.5E-08	2.5%
Benzene	1.3E-08	1.3%
Trichloroethane, 1,1,2-	5.3E-09	0.5%
Tetrachloroethene	2.3E-09	0.2%
Dichloroethene, 1,2-		
Dichloroethene, Cis-1,2-		
Trichloroethane, 1,1,1-		
Vinyl Acetate		
Pathway-Specific Subtotal	1E-06	100.0%
% of Total	100.0%	

TABLE 6-7
OPERABLE UNIT 2:
SUMMARY OF HIs FOR A GENERAL WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Ambient Air	Surface Soil		Chemical-Specific		% of Total
	Inhalation	Oral	Inhalation	Dermal	Subtotal	
MLE HI Estimates						
Benzene	1.4E-03				1.4E-03	48.5%
Total Petroleum Hydrocarbons		8.1E-05	1.2E-10	9.2E-04	1.0E-03	34.3%
Vinyl Chloride	4.8E-04				4.8E-04	16.5%
Trichloroethene	1.8E-05				1.8E-05	0.6%
Pathway-Specific Subtotal	1.9E-03	8.1E-05	1.2E-10	9.2E-04	3E-03	100.0%
% of Total	65.7%	2.8%	0.0%	31.6%	100.0%	
RME HI Estimates						
Total Petroleum Hydrocarbons		2.6E-03	9.9E-10	5.9E-02	6.1E-02	99.1%
Benzene	4.5E-04				4.5E-04	0.7%
Vinyl Chloride	1.2E-04				1.2E-04	0.2%
Trichloroethene	5.4E-06				5.4E-06	0.0%
Pathway-Specific Subtotal	5.8E-04	2.6E-03	9.9E-10	5.9E-02	6E-02	100.0%
% of Total	0.9%	4.2%	0.0%	94.9%	100.0%	

TABLE 6-8
OPERABLE UNIT 2:
SUMMARY OF HIs FOR AN EXCAVATION WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Perched Groundwater	Total Soil			Sediment		Chemical-Specific	
	Dermal	Oral	Inhalation	Dermal	Oral	Dermal	Subtotal	% of Total
MLE HI Estimates								
Total Petroleum Hydrocarbons	2.7E+00	3.8E-06	7.4E-07	4.4E-05			2.7E+00	99.8%
Trichloroethene	3.6E-03						3.6E-03	0.1%
Benzene	2.3E-04	2.0E-07	1.7E-09	2.2E-06	3.2E-05	3.6E-04	6.3E-04	0.0%
Methylnaphthalene, 2-	6.3E-04						6.3E-04	0.0%
Vinyl Chloride	5.6E-04						5.6E-04	0.0%
Dibenzofuran	2.2E-04						2.2E-04	0.0%
Naphthalene	8.4E-05						8.4E-05	0.0%
Manganese					6.0E-05	NA	6.0E-05	0.0%
Cadmium	4.9E-05						4.9E-05	0.0%
Nickel	2.3E-05						2.3E-05	0.0%
Phenanthrene	1.7E-05						1.7E-05	0.0%
Fluorene	8.7E-06						8.7E-06	0.0%
Tetrachloroethene	8.1E-06						8.1E-06	0.0%
Trichloroethane, 1,1,1-	7.5E-06						7.5E-06	0.0%
Dichloroethene, 1,1-	7.3E-06						7.3E-06	0.0%
Bis(2-Ethylhexyl)Phthalate	3.7E-06						3.7E-06	0.0%
Dichloroethene, Cis-1,2-	1.9E-06						1.9E-06	0.0%
Chromium	1.3E-06						1.3E-06	0.0%
Xylenes					2.9E-08	3.3E-07	3.6E-07	0.0%
Dichloroethane, 1,2-	2.7E-07						2.7E-07	0.0%
Methylene Chloride	1.6E-07						1.6E-07	0.0%
Pathway-Specific Subtotal	2.7E+00	4.0E-06	7.4E-07	4.6E-05	9.2E-05	3.6E-04	3E+00	100.0%
% of Total	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	
RME HI Estimates								
Total Petroleum Hydrocarbons	8.7E+01	6.5E-04	3.4E-05	1.5E-02			8.7E+01	99.5%
Trichloroethene	3.0E-01						3.0E-01	0.3%
Benzene	4.3E-03	7.3E-06	1.6E-08	1.7E-04	3.9E-03	8.7E-02	9.6E-02	0.1%
Methylnaphthalene, 2-	1.7E-02						1.7E-02	0.0%
Vinyl Chloride	1.1E-02						1.1E-02	0.0%
Dibenzofuran	4.0E-03						4.0E-03	0.0%
Nickel	2.9E-03						2.9E-03	0.0%
Manganese					2.7E-03	NA	2.7E-03	0.0%
Naphthalene	1.5E-03						1.5E-03	0.0%
Cadmium	9.7E-04						9.7E-04	0.0%
Trichloroethane, 1,1,1-	6.1E-04						6.1E-04	0.0%
Tetrachloroethene	3.2E-04						3.2E-04	0.0%
Phenanthrene	2.8E-04						2.8E-04	0.0%
Xylenes					1.1E-05	2.6E-04	2.7E-04	0.0%
Dichloroethene, 1,1-	2.2E-04						2.2E-04	0.0%
Fluorene	1.5E-04						1.5E-04	0.0%
Chromium	1.2E-04						1.2E-04	0.0%
Dichloroethene, Cis-1,2-	8.7E-05						8.7E-05	0.0%
Bis(2-Ethylhexyl)Phthalate	5.9E-05						5.9E-05	0.0%
Methylene Chloride	6.2E-06						6.2E-06	0.0%
Dichloroethane, 1,2-	4.4E-06						4.4E-06	0.0%
Lead								
Pathway-Specific Subtotal	8.7E+01	6.6E-04	3.4E-05	1.5E-02	6.5E-03	8.8E-02	9E+01	100.0%
% of Total	99.9%	0.0%	0.0%	0.0%	0.0%	0.1%	100.0%	

NA Not applicable.

TABLE 6-9
OPERABLE UNIT 2:
SUMMARY OF HIs FOR AN INDOOR WORKER
GEAE EVENDALE
(Page 1 of 1)

	Indoor Air	
Chemical	Inhalation	% of Total
MLE HI Estimates		
Vinyl Chloride	3.6E-03	59.4%
Dichloroethene, 1,1-	1.3E-03	21.1%
Trichloroethane, 1,1,1-	4.8E-04	7.8%
Dichloroethane, 1,2-	2.4E-04	3.9%
Dichloroethene, Cis-1,2-	2.1E-04	3.4%
Benzene	1.9E-04	3.0%
Trichloroethene	5.1E-05	0.8%
Tetrachloroethene	2.6E-05	0.4%
Methylene Chloride	3.2E-06	0.1%
Dibenzofuran		
Fluorene		
Methylnaphthalene, 2-		
Naphthalene		
Phenanthrene		
Pathway-Specific Subtotal	6E-03	100.0%
% of Total	100.0%	
RME HI Estimates		
Vinyl Chloride	4.9E-03	45.4%
Dichloroethene, Cis-1,2-	2.8E-03	26.0%
Dichloroethene, 1,1-	1.7E-03	16.2%
Trichloroethane, 1,1,1-	6.4E-04	6.0%
Dichloroethane, 1,2-	3.3E-04	3.0%
Benzene	2.5E-04	2.3%
Trichloroethene	6.8E-05	0.6%
Tetrachloroethene	3.5E-05	0.3%
Methylene Chloride	4.3E-06	0.0%
Naphthalene	8.8E-07	0.0%
Dibenzofuran	6.5E-07	0.0%
Fluorene		
Methylnaphthalene, 2-		
Phenanthrene		
Pathway-Specific Subtotal	1E-02	100.0%
% of Total	100.0%	

TABLE 6-10
OPERABLE UNIT 2:
SUMMARY OF RISK FOR A GENERAL WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Ambient Air		Surface Soil		Chemical-Specific	
	Inhalation	Oral	Inhalation	Dermal	Subtotal	% of Total
MLE Risk Estimates						
Trichloroethene	2.0E-08				2.0E-08	53.6%
Vinyl Chloride	1.3E-08				1.3E-08	35.1%
Benzene	4.2E-09				4.2E-09	11.3%
Total Petroleum Hydrocarbons						
Pathway-Specific Subtotal	3.7E-08				4E-08	100.0%
% of Total	100.0%				100.0%	
RME Risk Estimates						
Trichloroethene	3.6E-08				3.6E-08	57.4%
Vinyl Chloride	1.9E-08				1.9E-08	30.0%
Benzene	8.0E-09				8.0E-09	12.7%
Total Petroleum Hydrocarbons						
Pathway-Specific Subtotal	6.3E-08				6E-08	100.0%
% of Total	100.0%				100.0%	

TABLE 6-11
OPERABLE UNIT 2:
SUMMARY OF RISK FOR AN EXCAVATION WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Perched Groundwater	Total Soil			Sediment		Chemical-Specific	
	Dermal	Oral	Inhalation	Dermal	Oral	Dermal	Subtotal	% of Total
MLE Risk Estimates								
Trichloroethene	3.4E-09						3.4E-09	68.2%
Tetrachloroethene	6.0E-10						6.0E-10	12.2%
Dichloroethene, 1,1-	5.6E-10						5.6E-10	11.3%
Vinyl Chloride	3.0E-10						3.0E-10	6.1%
Benzene	2.9E-11	2.5E-14	1.2E-15	2.8E-13	4.0E-12	4.5E-11	7.8E-11	1.6%
Bis(2-Ethylhexyl)Phthalate	1.5E-11						1.5E-11	0.3%
Dichloroethane, 1,2-	1.1E-11						1.1E-11	0.2%
Methylene Chloride	1.0E-12						1.0E-12	0.0%
Cadmium								
Chromium								
Dibenzofuran								
Dichloroethene, Cis-1,2-								
Fluorene								
Lead								
Manganese								
Methylnaphthalene, 2-								
Naphthalene								
Nickel								
Phenanthrene								
Petroleum Hydrocarbons								
Trichloroethane, 1,1,1-								
Pathway-Specific Subtotal	4.9E-09	2.5E-14	1.2E-15	2.8E-13	4.0E-12	4.5E-11	5E-09	100.0%
% of Total	99.0%	0.0%	0.0%	0.0%	0.1%	0.9%	100.0%	
RME Risk Estimates								
Trichloroethene	2.8E-07						2.8E-07	82.6%
Tetrachloroethene	2.4E-08						2.4E-08	7.0%
Dichloroethene, 1,1-	1.7E-08						1.7E-08	4.9%
Benzene	5.3E-10	9.1E-13	1.2E-14	2.1E-11	4.8E-10	1.1E-08	1.2E-08	3.5%
Vinyl Chloride	6.2E-09						6.2E-09	1.8%
Bis(2-Ethylhexyl)Phthalate	2.3E-10						2.3E-10	0.1%
Dichloroethane, 1,2-	1.7E-10						1.7E-10	0.1%
Methylene Chloride	4.0E-11						4.0E-11	0.0%
Cadmium								
Chromium								
Dibenzofuran								
Dichloroethene, Cis-1,2-								
Fluorene								
Lead								
Manganese								
Methylnaphthalene, 2-								
Naphthalene								
Nickel								
Phenanthrene								
Total Petroleum Hydrocarbons								
Trichloroethane, 1,1,1-								
Pathway-Specific Subtotal	3.3E-07	9.1E-13	1.2E-14	2.1E-11	4.8E-10	1.1E-08	3E-07	100.0%
% of Total	96.7%	0.0%	0.0%	0.0%	0.1%	3.2%	100.0%	

TABLE 6-12
OPERABLE UNIT 2:
SUMMARY OF RISK FOR AN INDOOR WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Indoor Air	
	Inhalation	% of Total
MLE Risk Estimates		
Dichloroethene, 1,1-	1.2E-07	43.7%
Vinyl Chloride	9.9E-08	35.1%
Trichloroethene	5.7E-08	20.2%
Dichloroethane, 1,2-	1.8E-09	0.7%
Benzene	5.5E-10	0.2%
Tetrachloroethene	3.4E-10	0.1%
Methylene Chloride	2.7E-10	0.1%
Dibenzofuran		
Dichloroethene, Cis-1,2-		
Fluorene		
Methylnaphthalene, 2-		
Naphthalene		
Phenanthrene		
Trichloroethane, 1,1,1-		
Pathway-Specific Subtotal	3E-07	100.0%
% of Total	100.0%	
RME Risk Estimates		
Dichloroethene, 1,1-	9.8E-07	43.6%
Vinyl Chloride	7.8E-07	35.0%
Trichloroethene	4.5E-07	20.3%
Dichloroethane, 1,2-	1.5E-08	0.7%
Benzene	4.4E-09	0.2%
Tetrachloroethene	2.8E-09	0.1%
Methylene Chloride	2.1E-09	0.1%
Dibenzofuran		
Dichloroethene, Cis-1,2-		
Fluorene		
Methylnaphthalene, 2-		
Naphthalene		
Phenanthrene		
Trichloroethane, 1,1,1-		
Pathway-Specific Subtotal	2E-06	100.0%
% of Total	100.0%	

TABLE 6-13
OPERABLE UNIT 3:
SUMMARY OF HIs FOR A RESIDENT
GEAE EVENDALE
(Page 1 of 1)

Chemical	Ambient Air	
	Inhalation	% of Total
MLE HI Estimates		
Vinyl Chloride	7.8E-03	81.6%
Benzene	1.4E-03	15.0%
Trichloroethene	3.3E-04	3.4%
Pathway-Specific Subtotal	1E-02	100.0%
% of Total	100.0%	
RME HI Estimates		
Vinyl Chloride	1.5E-03	79.5%
Benzene	3.2E-04	16.8%
Trichloroethene	7.1E-05	3.7%
Pathway-Specific Subtotal	2E-03	100.0%
% of Total	100.0%	

TABLE 6-14
OPERABLE UNIT 3:
SUMMARY OF RISK FOR A RESIDENT
GEAE EVENDALE
(Page 1 of 1)

Chemical	Ambient Air	
	Inhalation	% of Total
MLE Risk Estimates		
Trichloroethene	7.8E-07	62.9%
Vinyl Chloride	4.5E-07	36.4%
Benzene	9.1E-09	0.7%
Pathway-Specific Subtotal	1E-06	100.0%
% of Total	100.0%	
RME Risk Estimates		
Trichloroethene	5.6E-07	65.5%
Vinyl Chloride	2.9E-07	33.8%
Benzene	6.7E-09	0.8%
Pathway-Specific Subtotal	9E-07	100.0%
% of Total	100.0%	

TABLE 6-15
OPERABLE UNIT 4:
SUMMARY OF HIs FOR A GENERAL WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Oral	Surface Soil		Ambient Air	Chemical-Specific	% of Total
		Inhalation	Dermal	Inhalation	Subtotal	
MLE HI Estimates						
Arsenic	2.2E-02	7.8E-09	1.0E-02		3.2E-02	94.5%
Vinyl Chloride				1.2E-03	1.2E-03	3.5%
Benzene				6.0E-04	6.0E-04	1.8%
Trichloroethene				4.4E-05	4.4E-05	0.1%
Lead						
Pathway-Specific Subtotal	2.2E-02	7.8E-09	1.0E-02	1.8E-03	3E-02	100.0%
% of Total	64.6%	0.0%	29.9%	5.5%	100.0%	
RME HI Estimates						
Arsenic	3.8E-01	3.6E-08	3.5E-01		7.2E-01	99.9%
Vinyl Chloride				2.9E-04	2.9E-04	0.0%
Benzene				1.9E-04	1.9E-04	0.0%
Trichloroethene				1.4E-05	1.4E-05	0.0%
Lead						
Pathway-Specific Subtotal	3.8E-01	3.6E-08	3.5E-01	5.0E-04	7E-01	100.0%
% of Total	51.9%	0.0%	48.0%	0.1%	100.0%	

TABLE 6-16
OPERABLE UNIT 4:
SUMMARY OF RISK FOR A GENERAL WORKER
GEAE EVENDALE
(Page 1 of 1)

Chemical	Oral	Surface Soil		Ambient Air	Chemical-Specific	% of Total
		Inhalation	Dermal	Inhalation	Subtotal	
MLE Risk Estimates						
Arsenic	5.9E-07	2.1E-12	2.7E-07		8.7E-07	91.2%
Trichloroethene				5.0E-08	5.0E-08	5.2%
Vinyl Chloride				3.2E-08	3.2E-08	3.4%
Benzene				1.8E-09	1.8E-09	0.2%
Lead						
Pathway-Specific Subtotal	5.9E-07	2.1E-12	2.7E-07	8.4E-08	9E-07	100.0%
% of Total	62.3%	0.0%	28.9%	8.8%	100.0%	
RME Risk Estimates						
Arsenic	6.0E-05	5.7E-11	5.6E-05		1.2E-04	99.9%
Trichloroethene				9.0E-08	9.0E-08	0.1%
Vinyl Chloride				4.7E-08	4.7E-08	0.0%
Benzene				3.4E-09	3.4E-09	0.0%
Lead						
Pathway-Specific Subtotal	6.0E-05	5.7E-11	5.6E-05	1.4E-07	1E-04	100.0%
% of Total	51.9%	0.0%	48.0%	0.1%	100.0%	

TABLE 6-17
COMPARISON OF CONCENTRATIONS OF CHEMICALS ELIMINATED BY THE
HEALTH-BASED BENCHMARK EVALUATIONS TO PRGs^a
GEAE EVENDALE
(Page 1 of 1)

Medium	Chemical	Concentration ^b		Ratio of Maximum Concentration to PRG
		Site Maximum ^c	PRG ^d	
Operable Unit 1				
Total Soil	Benzene	2.4E-01	1.4E+00	0.17
	Lead	4.2E+02	1.0E+03	0.42
Surface Soil	Benzo(a)Anthracene	3.9E-01	2.6E+00	0.15
	Benzo(b)Fluoranthene	5.4E-01	2.6E+00	0.21
	Lead	4.2E+02	1.0E+03	0.42
	Nickel	1.1E+03	3.4E+04	0.03
Sediment	Lead	5.1E+02	1.0E+03	0.51
Perched Groundwater	Methylnaphthalene, 2-	5.0E-03	2.4E-01	0.02
	Naphthalene	1.1E-02	2.4E-01	0.05
Operable Unit 2				
Total Soil	Trichloroethene	4.1E+00	7.0E+00	0.58
Surface Soil	Trichloroethene	3.5E-02	7.0E+00	0.00
Sediment	Ethylbenzene	8.9E+01	2.3E+02	0.39
	Toluene	4.7E+02	8.8E+02	0.53
Perched Groundwater	NA			
Operable Unit 3				
Surface Soil	Lead	6.5E+01	1.0E+03	0.07
	Nickel	1.3E+02	3.4E+04	0.00
	Total Petroleum Hydrocarbons	2.2E+02	3.6E+02	0.62
Operable Unit 4				
Surface Soil	Nickel	8.8E+02	3.4E+04	0.03

- ^a Comparisons performed for chemicals in exposure media only.
- ^b Soil and sediment concentrations in mg/kg; groundwater concentrations in mg/L.
- ^c See Sections 3.4.1 through 3.4.4.
- ^d Preliminary remediation goals (PRGs) for industrial soil (USEPA, 1996a).
- NA Not available; no chemicals eliminated by the health-based benchmark evaluation.



Legend



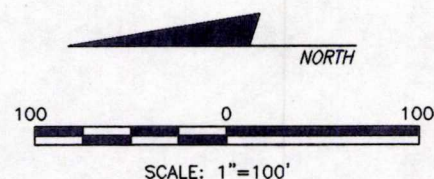
Scrapyard Area



Locations where samples
were analyzed for PCBs:

Sample Location	Aroclor-1248 (mg/kg)
8-SB10	7.4
8-SB11	0.28 (nondetect)
8-SB12	0.63
8-SB15	0.285 (nondetect)
8/12-SB13A	390
8/12-SB14	100
12-SB3	0.285 (nondetect)
12-SS1(1994)	85

NORTH DIRECTION AND SCALE:



G.E. Aircraft Engines Facility Evendale, Ohio



DRWN: tml	DATE: 2/98
CHKD	DATE
APPD	DATE
SCALE: AS SHOWN	

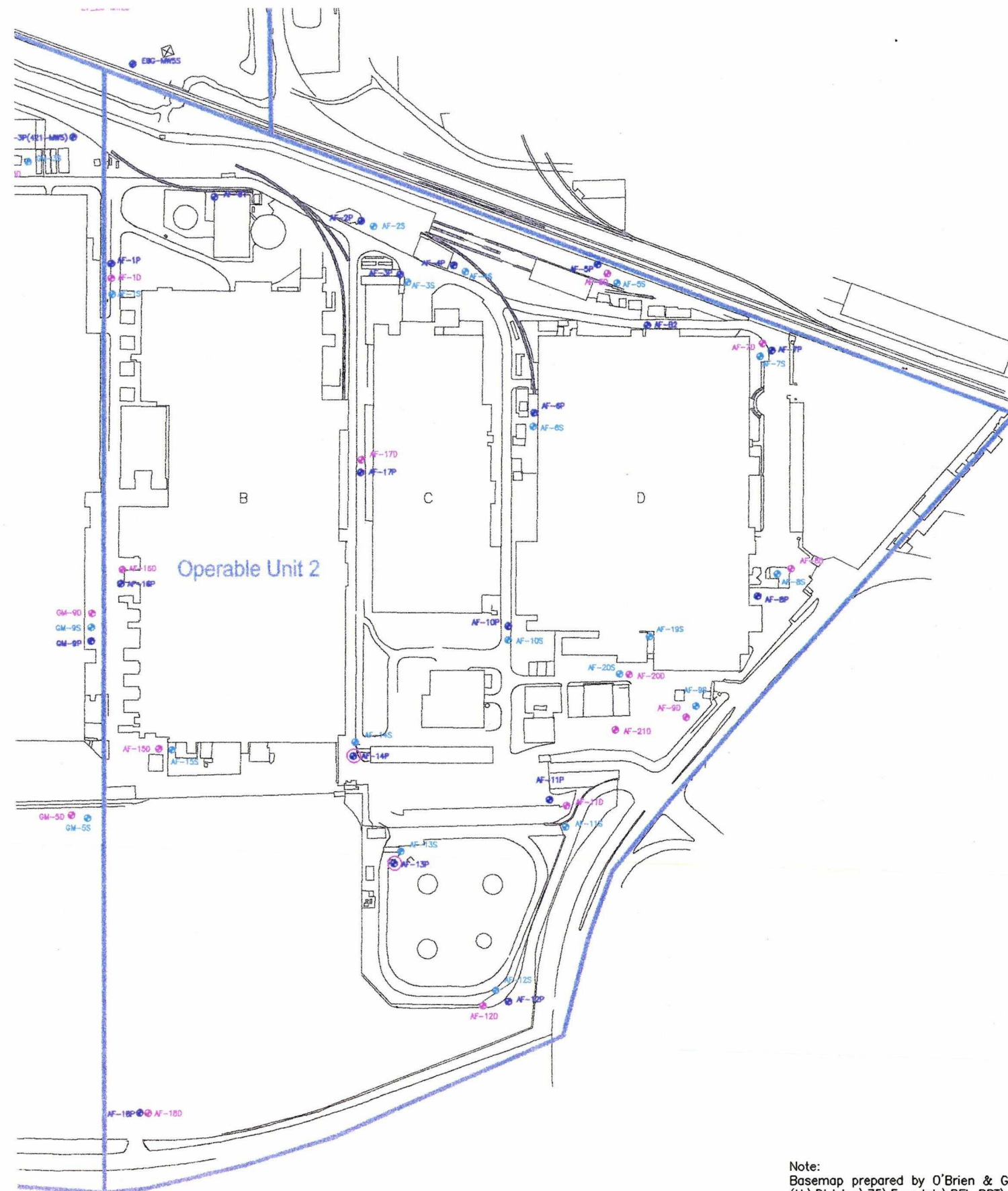
Scrapyard Area Soil Sample Locations

Filename: r:\3673\3673scrap.dwg
Plot File: r:\3673\3673gwat.pc2

DRAWING NUMBER
FIG. 6-1

Note:

Basemap prepared by O'Brien & Gere Engineers, Inc.
(H:\Division\75\Evendale\RFI-RPT\09F-22 SF=2400)
File Number: 4603.009-09F

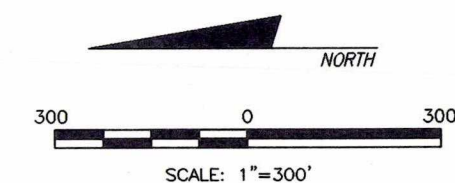


Legend

○ Locations where samples were analyzed for TPH:

Sample Location	Concentration (mg/L)
AF-13P	170,200
AF-14P	1.06

NORTH DIRECTION AND SCALE:



G.E. Aircraft Engines Facility Evendale, Ohio



DRWN: tml	DATE: 2/98
CHKD	DATE
APPD	DATE
SCALE	AS SHOWN

Operable Unit 2 Groundwater Sample Locations

Filename: r:\3673\3673ou2.dwg
Plot file: r:\3673\3673gwat.pc2

DRAWING NUMBER
FIG. 6-2

Note:
Basemap prepared by O'Brien & Gere Engineers, Inc.
(H:\Division\75\Evendale\RFI-RPT\09F-22 SF=2400)
File Number: 4603.009-09F

7.0 CONCLUSIONS

The human health risk assessment (HHRA) of the GE Aircraft Engine facility in Evendale, Ohio is an integrated assessment using all relevant information associated with Site Characterization (Section 2.0), Data Evaluation (Section 3.0), Toxicity Assessment (Section 4.0), and Exposure Assessment (Section 5.0). The Risk Characterization (Section 6.0) is then able to formulate estimates of noncancer and cancer risks based on this information. One primary objective of risk characterization is to understand the underlying assumptions associated with the estimates of risk or determine if potential health risks are insignificant relative to regulatory benchmarks for cancer and noncancer endpoints. The uncertainties in the results presented in risk characterization (Section 6.6) are inherent to the evaluation of potential risks using a baseline (*i.e.*, screening) risk assessment approach. The HHRA relies upon recommended USEPA guidelines for conducting a baseline assessment and, therefore, upper bound risk estimates are expected to be conservative estimates or overly protective of human health, and are not expected to underestimate potential risks.

The GEAE facility was separated in four distinct operable units (OU1 - OU4) to account for geographical differences, nature and extent of work activities and chemical distribution in media. The active facility portion of GEAE was separated into OU1 and OU2 (former Air Force Plant 36 property) and the inactive portions were separated into OU3 and OU4. The types of exposures that were addressed in this HHRA included a General (outdoor) Worker (OU1-OU4), an Indoor Worker (OU1, OU2), an Excavation Worker (OU1, OU2) and a Resident (OU3). Two levels of exposure were assumed for these population types: a more likely exposure (MLE) which represents the average exposure and a reasonable maximum exposure (RME) which represents the upper bound or 95 %tile exposure.

Inherent in the baseline risk assessment process is the potential to exaggerate potential health risks based on assumptions of exposure and use of integration methods that do not acknowledge implausible or unlikely conditions. The tendency to be overly protective in the baseline assessment is a conservative public health policy adopted by USEPA. Several assumptions made in this HHRA are noteworthy since their use is likely to overestimate the more likely risks at the facility.

- (1) The general worker spent all of his work time at outdoor locations (250 days/year). However, routine activities at the GEAE facility are conducted primarily indoors with work at outdoor locations limited to maintenance, excavation and building construction. No limitations were incorporated into the HHRA based on weather conditions. Typically, rain and snow often preclude contact with soil at least 30% of the year
- (2) The general worker made contact with contaminated media regardless of controls, barriers or protective clothing. This assumed that workers would be exposed to chemicals in soil even though concrete or asphalt structures may cover the soil, or protective clothing may be worn to preclude contact.
- (3) In many cases, the chemical concentration used in the RME evaluation was represented by the maximum detected value. This resulted from the statistical tests that were performed on analytical data from small data sets (less than 30 data points). Although

the procedures for conducting a baseline HHRA dictate the use of a maximum concentration in this situation, the likelihood of repeated exposures (250 days/years for 25 years) occurring at the location of maximum concentration is very small. An alternate evaluation is to incorporate the average concentration (*i.e.*, the MLE exposure point concentration) with upper bound RME exposure parameters. This would provide more reliable estimates of risk and is the methodology used to determine cleanup standards.

- (4) The excavation worker was assumed to make contact with perched groundwater during any type of excavation. This is unlikely to occur because perched groundwater is typically greater than 10 feet (bgs) at most areas of the facility.

A summary of the hazard indices (noncancer) and cancer risk estimates for the MLE and RME evaluations of exposure scenarios is provided below. For the hazard index (HI), a value of 1 or less indicates no further concern or analysis. For the cancer risk estimate, a value of 1E-06 or less is considered *de minimis* or zero and is not a concern. Risk estimates that fall between 1E-06 and 1E-04 are typically not a concern but often are evaluated further to insure that the result is not underestimated.

Cancer risk estimates for the Resident (OU3) and Indoor Worker (OU1, OU2) were generally not a concern because calculated values closely approximated the conservative regulatory benchmarks. All risk estimates calculated under the baseline HHRA for Operable Unit 3 were below regulatory benchmarks. For the General Worker and Excavation Worker, certain HIs exceeded a value of 1 and cancer risk estimates exceed 1E-06 (the *de minimis* level). The significance of these values was discussed in Section 6.0 and is summarized here according to operable unit.

Operable Unit 1

For the General Worker, the RME HI was estimated to be 70. The cancer risk estimates for the MLE and RME were 3E-06 and 9E-04, respectively. Dermal contact with and ingestion of Aroclor-1248 in surface soil contributed more than 97% of the RME HI (Table 6-1). Dermal contact with and ingestion of Aroclor-1248 in surface soil contributed more than 94% and 99% of the MLE and RME cancer risk estimates, respectively (Table 6-4). Several assumptions were significant in determining the magnitude of these values. The most important factor not considered in the baseline assessment is that the locations (SWMUs 8 and 12) of measured PCB concentrations are currently underneath asphalt or concrete. Therefore, no exposure are currently occurring and the risks are zero. Assuming that a general worker only spends an equal portion of his/her work time at SWMU 8/12 relative to the entire Operable Unit 1, the risk estimates can be adjusted accordingly by a factor of 0.01 (1%) or 100-fold less.

For the Excavation Worker, the RME HI and cancer risk estimate was 4 and 2E-06, respectively. Dermal contact with benzene in sediment contributed 59% and dermal contact with Aroclor-1248 in perched groundwater contributes 33% of the RME HI (Table 6-2). Dermal contact with Aroclor-1248 in perched groundwater contributes more than 82% of the RME cancer risk estimate (Table 6-2). For the RME evaluation, the maximum concentration for benzene in sediment (820 mg/kg) and Aroclor-1248 in groundwater (0.026 mg/L) were used to calculate the risk estimates. The

noncancer and cancer risk estimates were calculated using chronic (long-term) exposure criteria that are typically applied for exposures periods of 3 years or longer. The excavation scenario had a duration of 30-days and use of the chronic criteria is considered to be overly protective and likely to overestimate potential risks. Per USEPA guidance (USEPA, 1995), greater care should be taken in the risk characterization to ensure the exposure duration assumed in the exposure assessment corresponds with that used to derive the toxicity criteria. Based on these considerations, potential exposures for the excavation worker are not a concern unless they extend longer than 30-days and are conducted in the area of maximum concentrations of benzene or Aroclor-1248. These are unrealistic exposures in an excavation setting.

In summary, this HHRA demonstrates that potential noncancer and cancer risk estimates for the General Worker, Indoor Worker and Excavation Worker are not significant and residual chemicals in media do not pose an unacceptable risk for most of OU1. Specific areas and chemical concentrations that account for those risk estimates that exceeded regulatory benchmarks are presented below.

	SWMU	Chemical	Pathway
➤ Scrap & Salvage Yard Area	8/12	Aroclor 1248	Dermal/Ingestion-Soil
➤ O/W Separator 500-1	93/94	Benzene	Dermal-Sediment
➤ O/W Separator 500-2	95	Aroclor 1248	Dermal-Perched GW

Because RME exposure point concentrations for Aroclor 1248 (soil, groundwater) and benzene (sediment) results in using the maximum concentration, the only risk estimates for OU1 that results in values above the acceptable benchmarks were at these locations. All other chemicals and SWMUs within OU1 do not present a significant risk nor do residual chemical concentrations remaining in soil or groundwater (perched) pose an unacceptable risk.

Operable Unit 2

For the Excavation Worker, the RME and MLE HI were calculated to be 3 and 90, respectively. Dermal contact with TPH in perched groundwater contributed more than 99% to both the MLE and RME HI (Table 6-8). For the RME evaluation, the maximum concentration of 170,200 mg/L was used. This concentration exceeds the solubility limits of total petroleum hydrocarbons and does not represent exposure to groundwater per se. Both the RME and MLE HIs were calculated by assuming that the TPH product in groundwater was Group 1 (light fraction). If it is determined that the TPH is a heavier fraction (*e.g.*, diesel), then the HQ can be adjusted (decreased) by a factor ranging from 1.1 to 3.8. No other chemical measured in media at Operable Unit 2 were of concern.

In summary, this HHRA demonstrates that potential noncancer and cancer risk estimates for the General Worker (Outdoor) in OU2 are not significant and residual chemicals in media do not pose an unacceptable risk. For the Indoor Worker, the noncancer and cancer risk estimates are not significant including the marginal excursion of the RME cancer risk estimate of 2E-06. Although this value slightly exceeds the *de minimis* risk level (1E-06), the conservative nature of the upper bound (RME) evaluation and modeling predictions provide an adequate margin of safety to insure that there is no concern. For the Excavation Worker, only one medium (groundwater) and chemical (TPH) was identified that potentially posed a noncancer hazard. All cancer risk estimates for the

Excavation Worker are below the regulatory benchmark of $1E-06$. One area within OU2 and the associated chemical concentration for TPH accounted for all risk estimates that exceeded regulatory benchmarks for noncancer ($HQ > 1$) endpoints.

➤ SWMU 104/AOC G MW-13P TPH

Based on available data, no chemicals in soil were a concern for any of the exposure scenarios. All other chemicals and SWMUs within OU2 do not present a significant risk nor do residual chemical concentrations remaining in soil or groundwater (perched) pose an unacceptable risk.

Operable Unit 3

This HHRA evaluates potential exposures to a resident only for OU 3. Based on a comparison of the maximum detected chemical concentrations in OU3 to USEPA (Region 9) risk-based screening criteria for residential media, no chemical of concern are identified for the quantitative exposure assessment. The inhalation pathway was evaluated for the resident to characterize potential exposure to VOCs in ambient air that may be released from OU1 and OU2. All risk estimates for the resident inhalation pathway are below regulatory benchmarks and are not a concern. Therefore, all chemicals and SWMUs within OU3 do not present a significant risk nor do residual chemical concentrations remaining in soil or groundwater (perched) pose an unacceptable risk.

Operable Unit 4

For the General Worker, the RME cancer risk estimate was $1E-04$. Ingestion of and dermal contact with arsenic in surface soil contributed more than 99% of the RME cancer risk estimate (Table 6-16). The arsenic data set consists of four samples: 230, 23, 14, and 1.8 mg/kg. Three out of four of these results fall within the background range of 0.5 to 56 mg/kg for arsenic in Ohio farm soil (Cox and Colvin, 1996). However, the RME cancer risk estimate is calculated using the maximum detected concentration (230 mg/kg) as the exposure point concentration. It is unlikely that a worker would continuously contact only the maximum concentration. Additionally, although the RME cancer risk estimate is above the *de minimis* risk level (1×10^{-6}), it is within the acceptable regulatory risk range of $1E-06$ to $1E-04$. Although this adjusted risk estimate is above the *de minimis* level of $1E-06$, it essentially represents the upper background level of risks to naturally occurring levels of arsenic in soil.

Therefore, the noncancer and cancer risk estimates are below regulatory benchmarks and residual chemical concentrations do not pose an unacceptable risk for all SWMUs within OU4 except for a single sample location (29_30-SS4) within SWMU 29/30.

8.0 REFERENCES

AIC. 1994. Agency Information Consultants an ERIIS Company. Aerial photo. Austin, Texas. # 02-0047057.

Andelman, J.B. 1990. Total Exposure to Volatile Organic Chemicals in Potable Water. N.M. Ram, R.F. Christman, K.P. Cantor (eds.). Lewis Publishers.

ATSDR. 1993a. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Vinyl Chloride. Atlanta, GA.

ATSDR. 1993b. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs). Draft. Atlanta, GA.

ATSDR. 1994. Agency for Toxic Substances and Disease Registry. Toxicological Profile for 1,1,2,2-Tetrachloroethane. Draft. Atlanta, GA.

ATSDR. 1995. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Trichloroethene. Draft. Atlanta, GA.

BUSTR. 1994. Bureau of Underground Storage Tank Regulations. Risk Assessment Guidance Document for Risk Assessors and Project Managers. Draft. Ohio Department of Commerce. Division of State Fire Marshal. July 28, 1994.

Calabrese, E.J., Barnes, R., and Stanek, E.J. 1989. How Much Soil Do Young Children Ingest: An Epidemiologic Study. *Reg. Toxicol. Pharm.* 10:123-137.

Calabrese, E.J., Stanek, E.J., Gilbert, C.E., and Barnes, R.M. 1990. Preliminary Adult Soil Ingestion Estimates: Results of a Pilot Study. *Reg. Tox. Pharm.* 12:88-95.

Calabrese, E.J., and Stanek, E.J., III. 1991. A Guide to Interpreting Soil Ingestion Studies. *Regul. Toxicol. Pharm.* 13:278-292.

Calabrese, E.J., Stanek, E.J., and Gilbert, C.E. 1991. A Preliminary Decision Framework for Deriving Soil Ingestion Rates. In: (Kostecki, Calabrese, and Bell, eds.) *Hydrocarbon Contaminated Soils and Groundwater: Analysis, Fate, Environmental and Public Health Effects, Remediation* Volume I. Chelsea, MI: Lewis Publishers. pp. 301-310.

ChemRisk. 1997. Human Health Risk Assessment Work Plan for the GE Aircraft Engines Evendale Facility. January.

X Cox, C.C. and Colvin, G.H. 1996. Evaluation of Background Metal Concentrations in Ohio Soils. June.

D'Agostino, R.B., Belanger, A., and D'Agostino, R.B., Jr. 1990. A Suggestion for Using Powerful and Informative Tests of Normality. *The Am. Stat* 44(4):316-321.

Davis, S., Waller, P., and Buschbom, R. 1990. Quantitative Estimates of Soil Ingestion in Normal Children Between the Ages of 2 and 7 Years: Population-based Estimates Using Aluminum, Silicon, and Titanium as Soil Tracer Elements. *Arch. of Environ. Health* 45(2):112-122.

Dragun, J. 1988. The Fate of Hazardous Materials in Soil (What Every Geologist and Hydrologist Should Know): Part 2. *Hazardous Materials Control* 1(3):41-65.

Dragun, J., and Chiasson, A. 1991. *Elements in North American Soils*. Greenbelt MD: Hazardous Materials Control Resources Institutes.

Driver, J.H., Konz, J.J., and Whitmyre, G.K. 1989. Soil Adherence to Human Skin. *Bull. Environ. Contam. Toxicol.* 43:814-820.

ECAO. 1995. Environmental Criteria and Assessment Office. Systemic and Carcinogenic Toxicity Information for Multiple Chemicals. U.S. Environmental Protection Agency (Region V).

Earth Tech. 1997. Site Characterization Summary Informal Technical Information Report for the Groundwater Investigation of the Communication Area at Former Air Force Plant 36 Evendale, Ohio. May.

EPRI. 1989. Electric Power Research Institute. Installation Instructions for the MYGRT™ Program RP-2879-2 IBM/PC/DOS Version 2.0 Production. November.

EQ (Environmental Quality Management) and Pechan (E. H. Pechan and Associates). 1994. A Comparison of Soil Volatilization Models in Support of Superfund Soil Screening Level Development. Contract No. 68-D3-0035. Prepared for Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, DC.

Ershow, A.G., and Cantor, K.P. 1989. Total Water and Tapwater Intake in the United States: Population-Based Estimates of Quantities and Sources. Life Sciences Research Office, Federation of American Societies for Experimental Biology. Bethesda, Maryland.

ETG. 1994. ETG Environmental, Inc. Final Report. GE Aircraft Engines. Building 301, RECO #90076. Evendale, Ohio. August.

Farmer, W.J., and Letey, J. 1974. Volatilization Losses of Pesticides from Soils. EPA-660/2-74/054. Office of Research and Development, U.S. Environmental Protection Agency, Washington, DC.

Farmer, W.J., Yang, M.S., Letey, J., and Spencer, F. 1980. Land Disposal of Hexachlorobenzene Wastes. EPA-600/2-80/119. Office of Research and Development, U.S. Environmental Protection Agency, Washington, DC.

Finley, B.L., Proctor, D.M., and Paustenbach, D.J. 1992. An Alternative to the USEPA's Proposed Inhalation Reference Concentrations for Hexavalent and Trivalent Chromium. *Reg. Toxicol. Pharmacol.* 16:161-176.

Finley, B.L., Scott, P.K., and Paustenbach, D.J. 1993. Evaluating the Adequacy of Maximum Contaminant Levels as Health-Protective Cleanup Goals: An Analysis Based on Monte Carlo Techniques. *Regul. Toxicol. Pharmacol.* 18:438-455.

Finley, B., Proctor, D., Scott, P., and Harrington, N. 1994. Recommended Distributions for Exposure Factors Frequently Used in Health Risk Assessment. *Risk Analysis* 14(4):533-553.

Geraghty and Miller. 1986. Preliminary Assessment of Groundwater Conditions at the GE Evendale Plant. June.

Geraghty and Miller. 1987. Hydrogeologic Conditions at the GE Evendale Plant, Phase II Report. November.

Geraghty and Miller. 1988. Assessment of Hydrogeologic Conditions at the USAF Plant 36. November.

Gilbert, R.O. 1987. *Statistical Methods for Environmental Pollution Monitoring*. New York: Van Nostrand Reinhold.

Gillete, D.A. 1981. Production of Dust That May Be Carried Great Distances. Desert Dust: Origin, Characteristics, and Effect on Man. Geological Society of America Special Paper 186, T. Pewe, ed. pp. 11-26.

Hawley, J.K. 1985. Assessment of Health Risk from Exposure to Contaminated Soil. *Risk Anal.* 5(4):289-302.

Howard, P.H. 1989. *Handbook of Environmental Fate and Exposure Data for Organic Chemicals. Volume I: Large Production and Priority Pollutants*. Chelsea, MI: Lewis Publishers, Inc.

- Howard, P.H. 1990a. *Handbook of Environmental Fate and Exposure Data for Organic Chemicals. Volume I: Large Production and Priority Pollutants*. 3rd Ed. Chelsea, MI: Lewis Publishers, Inc.
- Howard, P.H. 1990b. *Handbook of Environmental Fate and Exposure Data for Organic Chemicals. Volume II: Solvents*. 2nd ed. Chelsea, MI: Lewis Publishers, Inc.
- Howard, P.H. 1991. *Handbook of Environmental Fate and Exposure Data for Organic Chemicals. Volume III: Pesticides*. Chelsea, MI: Lewis Publishers, Inc.
- Howard, P.H. 1993. *Handbook of Environmental Fate and Exposure Data for Organic Chemicals. Volume IV: Solvents 2*. Chelsea, MI: Lewis Publishers, Inc.
- Howard, P.H., Boethling, R.S., Jarvis, W.F., Meylan, W.M., and Michalenko, E.M. 1991. *Handbook of Environmental Degradation Rates*. 2nd Ed. Chelsea, MI: Lewis Publishers, Inc.
- HSDB. 1995. Hazardous Substances Data Bank. National Library of Medicine, U.S. Department of Health and Human Services. Public Health Service, National Institutes of Health. Washington, D.C.
- Hwang, S.T., and Falco, J.W. 1986. *Estimation of Multimedia Exposure Related to Hazardous Waste Facilities*. Y. Cohen, ed. Plenum Publishing.
- IT Corp. 1997. International Technology Corporation. Air Force Plant 36. Quarterly Report. October 1 - December 31, 1996. Groundwater Treatment System. May.
- Johnson, P.C., and Ettinger, R.A. 1991. Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors into Buildings. *Environmental Science and Technology* 25(8):1445-1452.
- Jury, W.A., Spencer, W.F., and Farmer, W.J. 1983. Behavior Assessment Model for Trace Organics in Soil: I. Model Description. *J. Environ. Qual.* 12(4):558-564.
- Jury, W.A., Farmer, W.J., and Spencer, W.F. 1984. Behavior Assessment Model for Trace Organics in Soil: II. Chemical Classification and Parameter Sensitivity. *J. Environ. Qual.* 13(4):567-572.
- Jury, W.A., Russo, D., Streile, G., and Abd, H.E. 1990. Evaluation of Volatilization by Organic Chemicals Residing Below the Soil Surface. *Water Resources Research* 26(1):13-20.
- King, L.D. 1988. Retention of Metals by Several Soils of the Southeastern United States. *J. Environ Qual.* 17:239-246.
- Klaassen, C.D., Amdur, M.O., and Doull, J., eds. 1986. *Casarett and Doull's Toxicology: The Basic Science of Poisons*. 3rd Ed. New York: Macmillan Publishing Co., Inc.

- Layton, D.W. 1993. Metabolically Consistent Breathing Rates for Use in Dose Assessment. *Health Physics* 64(1):23-26.
- Lepow, M.L., Bruckman, L., and Gillette, M. 1975. Investigations into Sources of Lead in the Environment of Urban Children. *Environ. Res.* 10:415-426.
- Lyman, W.J., Reehl, W.F., and Rosenblatt, D.H. 1982. *Handbook of Chemical Property Estimation Methods. Environmental Behavior of Organic Compounds*. New York: McGraw-Hill.
- McKone, T.E. 1987. Human Exposures to Volatile Organic Compounds in Household Tap Water: The Indoor Inhalation Pathway. *Environ. Sci. Technol.* 21:1194.
- McKone, T.E. 1990. Dermal uptake of organic chemicals from a soil matrix. *Risk Anal.* 10:407-419.
- McKone, T.E., and Bogen, K.T. 1991. Predicting the Uncertainties in Risk Assessment. *Environ. Sci. Technol.* 25(10):1674-1681.
- McKone, T.E., and Knezovich, J.P. 1991. The Transfer of Trichloroethylene (TCE) from a Shower to Indoor Air: Experimental Measurements and Their Implications. *J. Air Waste Manage. Assoc.* 41:832-837.
- Montgomery, J.H., and Welkom, L.M. 1989. *Groundwater Chemicals Desk Reference*. Chelsea, MI: Lewis Publishers, Inc.
- Mundell, J.A., Hill, K.R., and Weaver, J.W., II. 1989. *In situ* Case History: Leachable Lead Required Precipitation Immobilization. *Hazardous Waste Management* 23-27.
- NAS. 1977. National Academy of Sciences. *Drinking Water and Health*. Washington, D.C.: National Academy Sciences Press.
- NAS. 1983. National Academy of Sciences. *Risk Assessment in the Federal Government: Managing the Process*. Washington, D.C.: National Academy Sciences Press.
- NAS. 1989. National Academy of Sciences. *Recommended Dietary Allowances*. 10th Ed. Washington, DC: National Academy of Sciences Press.
- NSF. 1977. National Science Foundation. Lead in the Environment. In: Boggess W.R., ed. Washington, D.C.: National Science Foundation. NSF/RA-770214.
- OBG. 1995. O'Brien and Gere. RCRA Facility Investigation. GE Aircraft Engines, General Electric Company, Evendale, Ohio. September.

OBG. 1996. O'Brien and Gere. GE Aircraft Engines - Evendale, Ohio. Building 306 and Test Cell 46 SVE System Confirmational Sampling. March.

O'Flaherty, E.J. 1993. Physiologically Based Models for Bone-seeking Elements. IV. Kinetics of Lead Disposition in Humans. *Toxicology and Applied Pharmacology* 118:16-29.

OSHA. 1995b. Occupational Safety and Health Administration. 20 CFR 1910.1025. Lead.
Owen, B.A. 1990. Literature-derived Absorption Coefficients for 39 Chemicals Via Oral and Inhalation Routes of Exposure. *Reg Toxicol Pharmacol.* 11:237-252.

Parker, S.P., ed. 1993. *McGraw-Hill Encyclopedia of Chemistry*. 2nd Ed. New York: Mc-Graw-Hill Inc.

Paustenbach, D.J. 1987. Assessing the Potential Environmental and Human Health Risks of Contaminated Soil. *Comments Toxicol.* 1(3-4):185-226.

Paustenbach, D.J. 1989a. A Survey of Health Risk Assessment. In: (D.J. Paustenbach, ed.), *The Risk Assessment of Environmental and Human Health Hazards: A Textbook of Case Studies*. New York: Wiley.

Paustenbach, D.J. 1989b. Important Recent Advances in the Practice of Health Risk Assessment: Implications of the 1990s. *Regul. Toxicol. Pharmacol.* 10:204-243.

Pharmacopeia. 1990. The United States Pharmacopeia XXII. The National Formulary XVII. January 1990.

Que Hee, S.S., Peace, B., Clark, and C.S. 1985. Evolution of Efficient Methods to Sample Lead Sources, Such As House Dust and Hand Dust, in the Homes of Children. *Environ. Res.* 38:77-95.

Reeves, M., Ward, D.S., and Johns, N.D. 1986. Theory and Implementation for SWIFT II. The Sandia Waste-Isolation Flow and Transport Model for Fractured Media. Release 4.84, prepared for the U.S. Nuclear Regulatory Commission.

Reitz, R.H., Gargas, M.L., Andersen, M.E., Provan, W.M., and Green, T.L. 1996. Predicting Cancer Risk from Vinyl Chloride Exposure with a Physiologically-Based Pharmacokinetic Model. *Toxicol. Appl. Pharmacol.*

Roels, H.A., Buchet, J.P., and Lauwerys, R.R. 1980. Exposure to Lead by the Oral and the Pulmonary Routes of Children Living in the Vicinity of a Primary Lead Smelter. *Environ. Res.* 22:81-94.

Ryan, E.A., Hawkins, E.T., Magee, B., and Santos, S.L. 1986. Assessing Risk from Dermal Exposure at Hazardous Waste Sites. In: Health Assessment, E.C. Jordan Company, Wakefield, Massachusetts, p. 166-168.

Sax, N.I., and Lewis, R.J., Sr. 1989. *Dangerous Properties of Industrial Materials*. Volumes I to III. 7th Ed. New York: Van Nostrand Reinhold.

Til, H.P., Immell, H.R., and Feron, V.J. 1983. Lifespan oral carcinogenicity study of vinyl chloride in rats. Final Report. Civo Institutes, TNO. Report No. V 93.285/291099.

Til, H.P., Feron, V.J., and Immel, H.R. 1991. Lifetime (149-week) oral carcinogenicity study of vinyl chloride in rats. *Food Chem. Toxicol.* 29(10):713-718.

USCOE. 1987. U.S. Corps of Engineers. Corps of Engineers Wetland Delineation Manual.

USEPA. 1985a. U.S. Environmental Protection Agency. Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites. Office of Health and Environmental Assessment. EPA/600-8-85/002.

USEPA. 1985b. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors. Office of Air Quality Planning and Standards. PB86-124906.

USEPA. 1985c. U.S. Environmental Protection Agency. Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water--Part II. Environmental Research Laboratory, Athens, GA. EPA/600/6-85/002b. pages 314,318.

USEPA. 1986. U.S. Environmental Protection Agency. Air Quality Criteria for Lead. Research Triangle Park, N. C.: Office of Research and Development, Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office. EPA 600/8-83-028F.

USEPA. 1987a. U.S. Environmental Protection Agency. User's Guide: Emission Control Technologies and Emission Factors for Unpaved Road Fugitive Emissions. Air and Energy Engineering Research Laboratory. EPA/625/5-87/022.

USEPA. 1988a. U.S. Environmental Protection Agency. Selection Criteria for Mathematical Models Used in Exposure Assessments Ground-Water Models. Exposure Assessment Group, Office of Health and Environmental Assessment. Washington, D.C. EPA/600/8-88/075.

USEPA. 1988b. U.S. Environmental Protection Agency. Superfund Exposure Assessment Manual. Office of Emergency and Remedial Response Directive 9285.5-1. April, Washington D.C. EPA/540/1-88/001.

USEPA. 1989a. U.S. Environmental Protection Agency. Risk Assessment Guidance for Superfund, Volume 1. Human Health Evaluation Manual (Part A), Interim Final. Office of Emergency and Remedial Response, Washington, DC. EPA/540/1-89/002.

USEPA. 1989b. U.S. Environmental Protection Agency. Exposure Factor Handbook. Office of Health and Environmental Assessment, Washington, D.C. EPA/600/8-89/043. May.

USEPA. 1989c. U.S. Environmental Protection Agency. Hazardous Waste TSDF Fugitive Particulate Matter Air Emissions Guidance Document. Office of Air Quality Planning and Standards. USEPA Contract No. 68-02-4395. EPA/450/3-89-019.

USEPA. 1989d. U.S. Environmental Protection Agency. Review and Evaluation of Area Source Dispersion Algorithms for Emission Sources at Superfund Sites. EPA 450/4-89-020.

USEPA. 1989e. U.S. Environmental Protection Agency. Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and Dibenzofurans (CDDs and CDFs) and 1989 Update. EPA 625/3-89-016.

USEPA. 1989f. U.S. Environmental Protection Agency. RCRA Facility Investigation (RFI) Guidance. Volume IV of IV. Interim Final. EPA530/SW-89-031. May.

USEPA. 1991a. U.S. Environmental Protection Agency. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. Interim Final. Office of Solid Waste and Emergency and Remedial Response. OSWER Directive 9285.6-03. Washington, D.C.

USEPA. 1991b. U.S. Environmental Protection Agency. Risk Assessment Guidance for Superfund. Volume I. Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals), Interim. Office of Emergency and Remedial Response, Washington, DC. PB92-963333.

USEPA. 1991c. U.S. Environmental Protection Agency. User's Guide for the Fugitive Dust Model (FDM) Revised, User Instructions. Office of Air Quality Planning and Standards. Seattle, Washington. January.

USEPA. 1991e. U.S. Environmental Protection Agency. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. OSWER Directive 9355.0-30. Office of Solid Waste and Emergency Response. April 22, 1991.

USEPA. 1992a. U.S. Environmental Protection Agency. Dermal Exposure Assessment: Principles and Applications. Office of Research and Development, Washington, D.C. EPA/600/8-91/011B.

USEPA. 1992b. U.S. Environmental Protection Agency. Guidance for Exposure Assessment. 59 FR 22888. March 29.

USEPA. 1992c. U.S. Environmental Protection Agency. Risk Characterization for Risk Managers and Risk Assessors. Memorandum from Mr. Habicht, Deputy Administrator of the USEPA. February 26, 1992.

USEPA. 1992d. U.S. Environmental Protection Agency. Implementing Risk Characterization. Memorandum from Mr. Longest and Mr. Diamond. May 26, 1992.

USEPA. 1992e. U.S. Environmental Protection Agency. Comparison of a Revised Area Source Algorithm for the Industrial Source Complex Short Term Model and Wind Tunnel Data. EPA 454/R-92-014.

USEPA. 1992f. U.S. Environmental Protection Agency. Supplemental Guidance to RAGS: Calculating the Concentration Term. Volume 1, Number 1. Interim Final. Office of Solid Wastes and Emergency Response. Publication 9285.7-08. Washington, D.C.

USEPA. 1992g. U.S. Environmental Protection Agency. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities. Washington, DC: U.S. Environmental Protection Agency

USEPA. 1993a. U.S. Environmental Protection Agency. Appendix W to 40 CFR Part 51 - Guideline on Air Quality Models (Revised).

USEPA. 1993b. U.S. Environmental Protection Agency. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. Washington, DC: U.S. Environmental Protection Agency.

USEPA. 1994a. U.S. Environmental Protection Agency. Requirements for Preparation, Adoption, and Submittal of Implementation Plans. Proposed Rule. 40 CFR Parts 51 and 52. Federal Register. Monday, November 28.

USEPA. 1994d. U.S. Environmental Protection Agency. Guidance on Residential Lead-Based Paint, Lead-Contaminated Dust, and Lead-Contaminated Soil. Memorandum from Lynn R. Goldman, Assistant Administrator of the USEPA. July 14, 1994.

USEPA. 1994e. U.S. Environmental Protection Agency. Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (Version 0.99D). Office of Emergency and Remedial Response, Washington, DC. Publication No. 9265, PB93-963510. February.

USEPA. 1995a. U.S. Environmental Protection Agency. Policy and Guidance for Risk Characterization. Attachments to Memorandum from Ms. Browner, Administrator of the USEPA. March 21, 1995.

USEPA. 1995b. U.S. Environmental Protection Agency. Health Effects Assessment Summary Tables (HEAST), FY-1995. Washington, DC.

USEPA. 1995c. U.S. Environmental Protection Agency. Systemic and Carcinogenic Toxicity Information for Multiple Chemicals. Cincinnati, OH: U.S. Environmental Protection Agency, Technical Support Center, ECAO. March 15, 1995.

USEPA. 1995d. U.S. Environmental Protection Agency. User's Guide for the Industrial Source Complex (ISC3) Dispersion Models. Office of Air Quality Planning and Standards Emissions, Monitoring, and Analysis Division, Research Triangle Park, North Carolina. EPA-454/B-95-003a.

USEPA. 1996a. U.S. Environmental Protection Agency. Region IX Preliminary Remediation Goals (PRGs). San Francisco, CA.

USEPA. 1996b. U.S. Environmental Protection Agency. Soil Screening Guidance: Technical Background Document. Office of Solid Waste and Emergency Response. Washington, D.C. EPA540/R-95/128.

USEPA. 1996c. U.S. Environmental Protection Agency. Drinking Water Regulations and Health Advisories. Office of Water. EPA 822-R-96-001.

USEPA. 1996d. U.S. Environmental Protection Agency. Soil Screening Guidance. User's Guide. Office of Solid Waste and Emergency Response. Washington, D.C. EPA540/R-96/018.

USEPA. 1997. U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS).

USEPA. 1998. U.S. Environmental Protection Agency. Federal Register. Friday, January 2.

USGS. 1994. U.S. Geological Survey. Letter from Kathleen M. Sarver to George Walters, dated August 23, 1994 regarding former Air Force Plant 36 groundwater sampling results (June, 1994).

van Wijnen, J.H., Clausen, P., and Brunekreef, B. 1990. Estimated Soil Ingestion by Children. *Environ. Res.* 51:147-162.

Yang, J.J., Roy, T.A., and Krueger, A.J. 1989. *In vitro* and *in vivo* Percutaneous Absorption of Benzo(a)pyrene from Petroleum Crude-fortified Soil in the Rat. *Bull. Environ. Contam. Toxicol.* 43:207-214.